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# USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING



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23 November 1984

# USSR REPORT

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SIGNAL PROCESSING IN QUASI-HOLOGRAPHIC SYSTEM AS AN INVERSE PROBLEM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 8 Feb 82) pp 1242-1251

MUSH, B. S. and AL'TMAN, L. S.

[Abstract] The concept of quasi-holographic systems is introduced, which is defined as a system that realizes signal processing by solving inverse problems described by Fredholm-type integral equations of the first kind with finite difference kernels whose effective width becomes smaller as the spectrum becomes narrower when the known function of the integral equation is defined on a bounded interval. A regularized solution for this system of equations is obtained. The parameters needed in order to realize the methods are found by computer, and means are identified for increasing the output and reducing processing time. Figure 1; references 8: 6 Russian, 2 Western (in Russian translation).

[318-6900]

UDC 621.396.96'06

## METHOD OF STATIC MEASUREMENTS OF ABSOLUTE SCATTERING MATRIX OF RADAR TARGETS

Moscow RADIOTEKHNIKA i. Russian No 5, May 84 (manuscript received, after completion, 2 Aug 83) pp 31-33

POLIKARPOV, S. N.

[Abstract] A direct method of measuring the absolute scattering matrix in radar application is proposed, specifically a scattering matrix with pairs of signals polarized orthogonally at the transmitter end and at the receiver end. The theory of this method is based on the matrix  $V_1 = KHTSFGU_1$  ( $V_1 = v_1 v_2$

receiver output voltage,  $K = \begin{pmatrix} k_1 & 0 \\ 0 & k_2 \end{pmatrix}$  receiver matrix,  $H = \begin{pmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{pmatrix}$  matrix of

amplitude-phase indicator at receiver end,  $T = \begin{pmatrix} t_{11} & t_{12} \\ t_{21} & t_{22} \end{pmatrix}$  matrix of medium

between receiver and target,  $S = \begin{pmatrix} s_{11} & s_{12} \\ s_{21} & s_{22} \end{pmatrix}$  scattering matrix of target,

$F = \begin{pmatrix} f_{11} & f_{12} \\ f_{21} & f_{22} \end{pmatrix}$

matrix of medium between target and transmitter,  $G = \begin{pmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{pmatrix}$

matrix of amplitude-phase indicator at transmitter end,  $U_1 = \begin{pmatrix} u_1 \\ u_2 \end{pmatrix}$  transmitter

output voltage). Following several appropriate transformations, a simple relation  $S_{en} = Q_{en}A$  is obtained for an etalon reflector whose scattering matrix is known ( $Q = VU^{-1}$ ,  $A = Z^{-1}$ ,  $Z = Q_1 S_1^{-1}$ ) and then for the scattering matrix of the target  $S_m = Q_m A$  whose elements are to be determined from  $m$  measurements ( $A = Q_{en}^* T_{Q_{en}}^{-1} - Q_{en}^* T_{S_{en}}$ ). Figure 1; references 5: 2 Russian, 3 Western (1<sup>st</sup> in Russian translation). [301-2415]

# SELECTIVITY OF WEIGHT COMPENSATOR OF PASSIVE INTERFERENCE TO UNKNOWN VELOCITIES OF DETECTABLE TARGETS

Moscow RADIOTEKHNICA in Russian No 5, May 84 (manuscript received 14 Jul 83) pp 33-36

KISELEV, A. Z.

[Abstract] A linear weight compensator of passive interference is considered for detection of targets moving at unknown velocities within the range of a noncoherent radar. From the matrix equation  $Rd = \lambda R_i d$  ( $R = R_{si} - R_i$ ,  $R_{si}$  and  $R_i$  correlation matrices of signal and interference measurement vector  $d$ ,  $\lambda$  - largest root of equation  $|R - R_i| = 0$ ) and on the basis of the energy criterion, rather than the not quite applicable probability criterion, is determined the output signal-to-interference ratio as function of the Doppler phase shift  $\theta$  during one repetition period  $T_s$  of the probing signal. This relation with the measurement vector fixed yields the velocity characteristics of the compensator. As the number of simultaneously incoming processable pulses increases, the compensator ignores an increasingly wide range of velocities outside a narrow band with the center at  $\theta = \pi$  ( $\theta = 2\pi f_D T_s$ ,  $f_D$  - difference between mean frequencies of interference and reflected signal) and will asymptotically ignore all targets except those moving at velocity  $\theta = \pi$ . It is not possible to reduce this excessive selectivity and widen the Doppler frequencies band correspondingly without decreasing the mean detection efficiency. Figure 1; references 5: 3 Russian, 2 Western (1 in Russian translation). [301-2415]

# COMPREHENSIVE RADIO DIRECTION FINDER WITH ELECTRONICALLY STABILIZED RADIATION PATTERN

Moscow RADIOTEKHNICA in Russian No 5, May 84 (manuscript received, after abridgement, 10 Sep 83) pp 37-41

BOGACHEV, A. S.

[Abstract] A quasi-optimum comprehensive on-board radio direction finder with an electronically stabilized radiation pattern of its antenna array is synthesized according to the Markov theory of optimal nonlinear filtration. The antenna output signals are used for measurements and the output signals from the angular-coordinates channels of the inertial navigation system are used for control purposes, specifically for compensation of phase shifts of the antenna output signals produced by oscillation of the aircraft about its center of mass. The performance analysis is based on the differential equation for the state vector, the latter having been expanded so as to account for stochasticity of signal phases as well as for angular displacements of the

radio transmitter in an inertial system of coordinates because of intentional aircraft maneuvers and natural atmospheric turbulence. The vector of forming noise and its statistical characteristics are defined by a  $14 \times 14$  intensity matrix, assuming mutually independent stationary Gaussian "white" noise processes. The algorithm of data processing constructed on this basis is most efficient for a radio direction finder with a narrow radiation pattern. Figure 1; references 8: 7 Russian, 1 Western (in Russian translation). [301-2415]

UDC 621.396.969.11

#### CHARACTERISTICS OF DIGITAL RANGE FINDER WITH STROBOSCOPIC DISCRETIZATION

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received, after abridgement, 17 Sep 83) pp 44-46

NEZLIN, D. V. and CHERNYAKOV, M. S.

[Abstract] In digital range finders for detection of moving targets it is often necessary to lower the discretization frequency and thus to increase the speed of measurements without decreasing the accuracy and without additional equipment complexity. One method of achieving this is by stroboscopic discretization, which involves shifting the signal samples taken in successive periods of probing pulses by a time interval  $\Delta t = T_1/nN$  ( $n$  - number of discretization pulses per signal pulse of duration  $T_1$  during each one of  $N$  tracking periods). For a nontracking digital range finder of a pulse radar the error of measuring the time position of the pulse center depends not only on the number of readings but also on the voltage waveform at the range finder input, this waveform varying from triangular in the case of an exactly matched preceding stage to almost rectangular in the case of complete mismatch. A comparative analysis of stroboscopic and conventional discretization by computer simulation with a typical number of  $N$  tracking periods and a 20 dB signal-to-noise ratio at the range finder input has revealed that stroboscopic discretization reduces the error of range measurement appreciably when the number of discretization pulses per signal pulse is smaller than the number of readings which ensures a sufficiently small error with conventional discretization. Attendant decorrelation resulting in a weaker suppression of passive interference can be overcome by interperiod compensation, but the suppression remains less than in the case of conventional discretization and only approaches that in the latter case when  $n$  increases toward infinity. This is demonstrated for single and double interperiod compensation. Figures 2; references 3: 2 Russian, 1 Western. [301-2415]

## AMPLITUDE STABILIZATION OF PULSE SIGNALS

Moscow RADIOTEKHNICA in Russian No 5, May 84 p 92

[Annotation of article deposited at Central Scientific and Technical Institute 'Informsvyaz'', No 303]

KORSHUNOV, Yu. M. and SIMKIN, A. V.

[Abstract] A digital amplitude stabilizer is considered for pulses with unknown timing, with slowly varying multiplicative interference and with high-frequency additive interference. The stabilization problem is solved by the method of minimum mean-square error. An analog amplitude stabilizer is also constructed, for comparison. Pages 15, Figures 2, References 9.  
[301-2415]

## VATRA TELEVISION COMPLEX FOR SALYUT ORBITAL SPACE STATION

Moscow TEKHNICA KINO TELEVIDENIYA in Russian No 6, Jun 84 pp 3-5

BRATIVNYK, Ya. G., BRILLIANTOV, D. P. and MOVCHAN, V. V.

[Abstract] Early spacecraft had one-way TV systems but increased information and astronaut psychological support needs in long flights including contacts with friends and relations on the ground led to the development of the two way Vatra system for Salyut-6 spacecraft. The system was improved during three long Salyut-6 expeditions, and the fourth trip utilized a variant with an optical telecamera adaptor for observing the dark side of the Earth as well as stars and galaxies in the infrared range. The design objectives are compactness, reliability and minimal energy consumption and mass. Silicon solar batteries are the energy source supplying around 0.7 W per square decimeter of illuminated surface. Spacecraft voltage goes from 34 to 23 V when it passes into the unilluminated zone. The complex consists of a switch unit, portable videorecorder, TV camera, monitor (with 23 cm diagonal picture tube), an acoustic system and a TV transmitter and receiver. The complex can take images and display, transmit and receive either live or on tape. It has been repeatedly tested and found adequate. Figures 2; references: 3 Russian.  
[296-12497]

## POTENTIAL COORDINATE ESTIMATION ACCURACY BY MULTIPOSITION RADAR SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 11 Nov 82) pp 1322-1329

KREMER, A. I.

[Abstract] Expressions are derived for the potential accuracy of measurements of the coordinates of a small target by active coherent and video-coherent multiposition radar systems for the case of a target in the far zone, in the near zone and in the Fresnel zone of the radar. It is shown that video-coherent multiposition radar systems are inferior to coherent systems in coordinate measurement accuracy (especially angular), even assuming high signal-to-noise ratios at the receiving locations. Coherent systems are found to be superior because of their use of the phase structure of the received field in the apertures of the receiving antennas within the entire spatial base. Phase information at all of the receiving points is utilized separately in video-coherent systems. The author expresses his suggesting the use in the paper for the curves of figures 2-5, the arrangement calculated specifically by him of the points of the multiposition radar systems.  
[318-6900]

## OPTIMAL COMPLEX NONLINEAR PROCESSING OF CONTINUOUS AND PULSED SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 7 Apr 83) pp 1330-1338

YARLYKOV, M. S., MIRONOV, M. A. and ARTEMENKOV, V. S.

[Abstract] Optimal algorithms for complex nonlinear processing of continuous and pulsed signals which depend upon the same functionally related random processes are derived on the basis of the Markov theory of optimum nonlinear filtering. The optimal complex estimation algorithms are derived on the assumption of comparatively slow fluctuations in the filtered process over times much shorter than the pulse duration. This makes it possible to realize the advantages of optimal estimation of the parameters of a pulsed signal and optimal nonlinear filtering of continuous signals. Quasi-optimal algorithms for complex processing of continuous and pulse signals can also be obtained when some of the observations are made against the background of colored noise. The reception and processing of signals aboard a mobile platform with a stationary radio signal source is analyzed as an example. Figures 4; references: 12 Russian.  
[318-6900]

DETECTION OF SIGNALS FROM COHERENT PULSED RADARS WITH RANDOM VARIATION IN PARAMETERS OF SOUNDING SIGNALS FROM PULSE TO PULSE AGAINST BACKGROUND OF WORST-CASE GAUSSIAN NOISE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 6 Oct 82) pp 1339-1346

RODIONOV, V. V.

[Abstract] The structure and detection characteristics of coherent pulsed radars with random variation in the carrier frequency, initial phase and time-axis position of each pulse burst are investigated. A method is presented for finding the weight function of an optimal receiver and the signal-to-noise ratio at its output. The method can be used to investigate noise tolerance characteristics and to find the optimum receiver structure for variation in any of the parameters of the sounding signals, either separately or together. It is found that the signal-to-noise ratio and receiver structure remain unchanged if the condition of Gaussian noise is eliminated, because only the correlation functions of these processes are used. Figures 2; references: 5 Russian.  
[318-6900]

UDC 621.391

SYNTHESIS OF ADAPTIVE FILTERS FOR TRACKING RADIO SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 4 Oct 82) pp 1379-1384

SHLOMA, A. M., FROLOV, S. M.

[Abstract] The problem of adaptive filtering in tracking radio systems is solved by using invariant randomized estimates of the unknown parameters. The fiducial approach employed makes it possible to derive closed identification and filtering algorithms when there is parametric indeterminacy in assigning the initial data. References: 6 Russian.  
[318-6900]

UDC 621.396.677.49

DIGITAL HOLOGRAPHIC SYNTHESIS OF PATTERN-FORMING TRANSPARENCIES FOR RING ANTENNA ARRAYS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 28 Dec 82) pp 1266-1273

GRINEV, A. Yu., YAROSLAVSKIY, L. P., MERZLYAKOV, N. S., TEMCHENKO, V. S.  
and VORONIN, Ye. N.

[Abstract] Digital holographic methods are described for synthesizing the pattern-forming transparency employed in the coherent optical processor of ring antenna arrays performing parallel azimuth and frequency scanning at fixed elevations. The structure of the pattern-forming transparency is analyzed, and the digital holographic transparency recording is described. The results of experimentation with the coherent optical processor of a ring array are presented. The findings confirm the possibility of replacing digital processors with coherent optical processors for handling the signals produced by ring (cylindrical) antenna arrays. The authors thank Yu. V. Kotov and V. N. Shalayev for assistance during realization of the pattern-forming transparency. Figures 6; references 8: 6 Russian, 2 Western (in Russian translation).  
[318-6900]

UDC 523.164

VARIATION IN RADIOWAVE PROPAGATION CONDITIONS IN CORONA DURING SOLAR ACTIVITY CYCLE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 7 Jan 83) pp 1274-1279

YEFIMOV, A. I., YAKOVLEV, O. I., SHTRYKOV, V. K. and ROGAL'SKIY, V. I.

[Abstract] Observations of signals from space vehicles are analyzed in order to identify long-term changes in radio wave propagation conditions in the plasma near the sun and the factors underlying these changes. It is found that there are long-term changes in propagation conditions with periods of

several years, in addition to short-term variations with characteristic times of 5-20 days. These changes are caused by variations in the density of the plasma flux in the path of the radio waves. As the electron concentration increases so do the irregularities in the index of refraction, which cause increased radio wave scattering and increased amplitude and phase fluctuations, as well as broadening of the spectral line. Figures 3; tables 2; references 30: 5 Russian, 25 Western.  
[318-6900]

UDC 621.396.67.01

ADAPTIVE SYNTHESIS OF ANTENNAS WITH SEPARATION OF SIGNALS BY DIRECTION OF ARRIVAL

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 12 May 82) pp 1306-1315

AYZIN, F. L. and KOZAN, B. L.

[Abstract] A model is developed of an adaptive procedure for synthesizing an antenna with signal separation by direction of arrival, which employs phase processing in the aperture of a phase array. The model makes it possible to identify the basic regularities in the relationship between the rate of convergence, and the signal division efficiency, as a function of the parameters of the algorithm and the device which implements the processing. The model is helpful during the initial stage of the synthesis, because it makes it possible to reduce the region in which the optimizing parameters are sought. The modeling of an adaptive process of reducing the directivity pattern level in the direction of the source of an interfering signal for a 200-element flat switched phased array is presented as an example. Figures 6; references: 3 Russian.  
[318-6900]

COMPARATIVE CHARACTERISTICS OF OPTICAL MULTIPOSITION PULSE SIGNALS WITH  
INTERSYMBOL DISTORTION

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received after  
completion 21 Jun 83) pp 11-16

GAVLIN, M. E. and YEMIN, V. I.

[Abstract] The performance of fiber optics in a receiver-amplifier channel transmitting optical multiposition pulse signals is comparatively evaluated in terms of the signal-to-noise ratio at any given instant of time. As a basic receiver, one is considered which consists of a photodetector, a resistive-capacitive load, a wideband amplifier and a threshold device. The statistical characteristics of detection are calculated, using the waveform of a one-electron input pulse as a reference and extending the relations to a Gaussian binary signal with a conditionally Poissonian noise of intersymbol interference. An analysis of the dependence of the signal intensity or signal-to-noise ratio on the receiver bandwidth and the duration of the equivalent square pulse (having the same area as the Gaussian pulse and an amplitude corresponding to the maximum value) reveals the existence of a threshold associated with fluctuation of the random interference intensity. It also reveals a decrease of the signal-to-noise ratio with an increasing bandwidth within the linear range of the characteristics, which is attributable to a decrease of the mean signal intensity in a manner typical of optical signals as well as to inadequacy of single readouts. It is not necessary completely to erase the threshold as it is sufficient to raise it enough to ensure the necessary signal-to-noise ratio. This is best achieved by increasing the bandwidth of the receiver channel, addition of signal correctors at the receiver output not being as effective because of the attendant increase of thermal and shot noise. Abatement of intersymbol distortion is demonstrated on 8-position and 4-position signals with relative keying and time equalization, the latter either by transpositions or by means of exclusion intervals. Figures 3; references 6: 1 Russian, 5 Western (2 in Russian translation). [301-2415]

## REFRACTION OF NARROW PROBING LIGHT BEAM IN MULTILAYER OPTICAL FIBER

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received, after abridgement, 14 Jul 83) pp 73-76

MIROVITSKAYA, S. D. and KUDRYAVTSEV, D. L.

[Abstract] For an experimental design and performance evaluation of optical fibers, it is necessary to establish an analytical relation between the refraction angle of a probing light beam and the geometrical parameters of the fiber. Here the problem is solved by application of Snell's law for a narrow light beam, first to a double-layer fiber consisting of a gradient core inside a homogeneous sheath and then to a triple-layer fiber consisting of a gradient core inside a double-layer sheath. Figures 3; references 3: 1 Russian, 2 Western.

[301-2415]

UDC 681.7.068.4.001.5:621.372.8.029.7

## TEMPERATURE SENSITIVITY OF FIBER-OPTIC TRANSMISSION LINE

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received 5 Jul 83) pp 76-80

SHATALOV, F. A.

[Abstract] The temperature sensitivity of multilayer fiber-optic transmission lines with a power-law profile of the refractive index is evaluated in two ways: 1) With temperature and strain components in the core as the independent variables; and 2) With temperature and stress components in the core as the independent variables. The relations for the temperature coefficient of the refractive index at zero strain or at zero stress, respectively, yield in each case the corresponding condition for temperature insensitivity (zero temperature coefficient of the refractive index). For fibers with small numerical aperture it is assumed that the Poisson ratio varies insignificantly while the Young modulus and the coefficient of thermal expansion vary linearly with the refractive index as a function of the radial coordinate in the fiber core. The accuracy of this approximation is checked against experimental data and found to be satisfactory for three-, four-, five-layer fibers (N. Lagaskos and J. A. Bucaro, J. APPLIED OPTICS Vol 20, Nos 13 and 19, 1981). The results are applicable to fiber materials with positive thermo-optical coefficient and almost zero coefficient of thermal expansion, as well as to fiber materials with negative thermo-optical coefficient of stress and large coefficient of thermal expansion (neodymium-activated lead-phosphate glasses, fluorophosphate glass, glassy metaphosphates). References 13: 6 Russian, 7 Western (1 in Russian translation).

[301-2415]

## DEPTH DIMENSION COMPRESSION OF 3-D IMAGES

Moscow KINO I TELEVIDENIYA in Russian No 6, Jan 84 pp 5-10

IGNAT'YEV, N. K., All-Union Scientific-Research Motion Picture Institute

[Abstract] As holography develops, there is renewed interest in noncoherent light photography including possibilities for three-dimensional views utilizing the parallax-panoramogram method in which the lenticular grating carrier of the fixed image has a limited depth of resolution of approximately 10% of the distance of the scene. This principle was used to develop a method of noncoherent parallax-panoramogram photography with depths extending from close to the camera to unlimited distances. An optical scheme and the main formula are presented for the compression and range effects. Compression is considered from the point of view of comparison of image parameters with the fixed image and it is shown that the compressed 3-D image does not distort the original. This method can be used for holographic rerecording and can thus extend the possibilities for noncoherent photography with holographic applications. Figures 7, references 4: 3 Russian, 1 Japanese. [296-12497]

UDC 778.53-752.4

## NIKFI-MKKB IMAGE INSTABILITY COMPENSATOR

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 6, Jun 84 pp 10-12

TOROCHKOV, V. Yu., All-Union Scientific-Research Motion Picture Institute

[Abstract] Gyroscopic attachments for compensating motion picture camera oscillations should be small and have good invariance. Liquid prism and mirror types are used at the present time. A system developed jointly by NIKFI and MKKB is a mirror system which consists of a mirror fixed to the camera and another gyroscope-controlled mirror which is able to retain the original position and to shift the image penetrating to the film. Ray analysis showed that the gyroscope-controlled mirror must compensate by turning one-half the angle of the shift of the fixed mirror. The special feature is the three-stage gyroscope which retains the original optical axis position of the camera. An experimental model with dimensions of 214 x 112 x 100 mm weighed 0.9 kg. The large mirror made it possible to use the system for lenses up to 50 mm. For oscillations greater than 0.5 Hz, the experimental model error did not exceed 20%. The system is considered better than the West German Arnold and Richter equipment. Figures 2; references: 2 Russian. [296-12497]

## LIGHT OPTICAL CHARACTERISTICS OF EYEPIECE LENSES OF MOTION PICTURE CAMERAS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 84 pp 12-18

SHADRINA, L. P. and YARINOVSKAYA, A. L., Moscow Motion-Picture Camera Design Office

[Abstract] Improvements in motion picture film sensitivity and lenses mean that less illumination is required for filming, but the disadvantage is that while 15-years ago eyepiece brightness was excessive and filters were used, today perceived light is 5 or more times less bright. The eyepiece has also become more complex in design with compensation features and light splitting for viewers or exposure units so that the transmission coefficient for the simple SK-1 camera eyepiece is 0.7 while for the complex 5KSN camera it is 0.2. Procedures are presented for evaluating eyepiece transmission and brightness coefficients. Perceived illumination can be improved by advanced optical coatings, but because faster films will probably be introduced it is expected that the required eyepiece illumination will not be attained and vidicon transmission will have to be used. Figures 7, tables 2, references: 3 Russian.  
[296-12497]

UDC 771.345:771.347.5

## MEASUREMENT OF PANORAMIC HEAD MOTION BY GYROSCOPIC SENSOR METHOD

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 84 pp 18-20

MELAMED, Yu. I., RUDINSKIY, I. F. and UVAROV, A. S.

[Abstract] Nonuniformity in pan heads can lead to film wastage and a new method is presented for evaluating the coefficient of nonuniformity for angular velocity of liquid damped heads by means of a gyroscopic sensor. Tests were made for domestic and foreign equipment with the three-coordinate BDG-10-1 sensor unit installed on the head and the results were transcribed by the N-338/4 recorder. The new method showed that the heads had higher nonuniformity coefficients than previous standard methods had indicated and can establish interrelations between different performances and evaluate repair quality. Analysis of results reveal the general characteristics of liquid damped pan heads including a tendency to reduced panning speed with time independently of the original position or rotation direction. The tests showed the superiority of the method to previous procedures and it is recommended that it be used for other scientific and technical film applications and in motion picture filming where 25% of waste is due to pan head defects. The gyroscope method can also be used for other rotary devices and for establishing standards. Figures 5, table 1.  
[296-12497]

## COMPRESSION OF DIGITAL TV PROGRAM BIT STREAM TO 34 Mbit/s

Moscow TEKHNIIKA KINO I TELEVIDENIYA in Russian No 6, Jun 84 pp 33-37

MERENKOV, V. N., MURDZHIKNELI, G. G., NIKOLAYEV, G. O., ORANSKIY, S. V. and SHOSTATSKIY, N. N., All-Union Scientific-Research Television Institute

[Abstract] CCIR recommendations for digital coding of brightness and two color-difference signals (13.5 MHz frequency for brightness and 6.75 MHz for color-difference signals) involve an 8-bit system and a digital flow for one program is 216 Mbit/3 so that transmission on a 34.368 Mbit/s channel requires compression by a factor of 6. Because of quality requirements this is difficult to carry out. The most widely used system is now 3-bit pulse code modulation where acceptable compression is possible by reducing the analog-to-digital conversion frequency. However, noise is generated by the quantizing and conversion frequencies. A hybrid compression system is proposed which satisfies CCIR recommendations. Compression is attained by multiplexing brightness and color-difference signals with 3-bit modulation and an improved adaptation algorithm with the required compression of 34 Mbit/s and the recommended analog/digital conversion frequency. Half the brightness signal in one field is excluded and replaced by color-difference signals. The excluded elements can be correctly reproduced by three-dimensional interpolation. The transmission rate could be further reduced by interframe image treatment. Figures 3, tables 5, references: 3 Russian, 2 Western. [296-12497]

## FEATURES OF USE OF K1118PA1 IC DIGITAL/ANALOG CONVERTER FOR TV IMAGE REGENERATION

Moscow TEKHNIIKA KINO I TELEVIDENIYA in Russian No 6, Jun 84 pp 37-39

GRESHISHCHEV, Yu. M., GUDNOV, A. G., MARTSINKYAVICHYUS, A. K., MARTSINKYAVICHYUS, I. K. and POSHYUNAS, R. L.

[Abstract] K1118PA1 integrated circuits are probably suitable for widespread use in digital/analog converters. This 8-bit circuit has the resolution capacity, nonlinearity and time determination characteristics necessary for decoders in planned TV digital systems, digital oscilloscope and other equipment. A description is given of the inclusion of this IC into a TV decoding regeneration circuit where error requirements for transmission coefficient, zero drift and time determination are not strict. The problem encountered consists of local defects of characteristics, i.e., differential nonlinearity and, especially switching peaks at the output. Peaks occur when code changes are made because of the output circuit connection. A special nonlinear filter is suggested for eliminating peaks. Analysis of the regenerated black-and-white TV imagery did not explain certain distortions including almost indiscernible vertical threading which seems to be caused by the switching peaks. Figures 4, tables 1, references: 1 Russian, 1 Western. [296-12497]

## LI481 AND LI482 VIDICONS FOR TWO-TUBE COLOR TV CAMERAS WITH IMPROVED IMAGE QUALITY

Moscow TEKHNICA KINO I TELEVIDENIYA in Russian No 6, Jun 84 pp 39-41

GERSHBERG, A. Ye., GOLOVINA, A. P., KUZ'MINOVA, Z. I., KORSHUNOVA, G. I., MARKIZOV, A. S., MIKHAYLOV-TEPLOV, N. N. and NIZHEGORODOV, S. P.

[Abstract] Two-tube color TV cameras are preferable to three-tube systems because they are smaller, require less power and have a simpler design, while operational characteristics are better than one-tube systems. At present, the 13-mm LI465-1 and LI472 vidicons are serially produced in the USSR. The first camera incorporating them was the Ts826. In the new system the 26 mm LI481 generates the green and the LI482 the blue and red components. A compound beam control system (electrostatic focussing and magnetic deviation) is used without a focussing coil, which reduced power needs and mass. One generator can be used for the two tubes. An optoelectronic crossed lens systems made it possible to use lower voltages than in comparable tubes. The photodiode targets are cadmium selenide for high sensitivity and good characteristics and fiber optical code filter discs give good transmission. The new system has improved resolution, signal-to-noise ratios and color quality while low color distortion makes combination of the green and red-blue easy with no distortion in the field center. The individual units of the device were developed under the direction and active participation of A. N. Derevyagin, I. I. Shipilov, G. F. Nikolayev, V. I. Upit, Z. M. Dvorkin, L. G. Kuznetsov, I. A. Petrov and L. V. Vasil'yev. Figures 6, references: 5 Russian.

[296-12497]

UDC 778.588:778.534.2]:778.68].002.5

## 'TSVET-2M' TV COLOR ANALYZER

Moscow TEKHNICA KINO I TELEVIDENIYA in Russian No 6, Jun 84 pp 43-46

GRINENKO, E. N. and ZOTOV, G. I., TsKBK NPO "Ekran"

[Abstract] Color analysis units which select conditions for printing color film simplify processing. However, domestic and foreign equipment now used in insufficiently precise and additional corrections are then necessary while the increase in the types of film materials made improved equipment necessary. The "Tsvet-2M" determines conditions for printing 16 and 35 mm films by means of electronic modelling of the printing process and reproduces the modelled image on a viewer. Intended for stationary use in TV centers and film studios, it performs counting and documentation operations and records reproduction conditions on perforated tape. The unit consists of a videosegment sensor generating color-separation video signals and transporting film at required speeds, a TV unit processing video signals in accord with an image modelling algorithm, a documentation unit for fixing exposure values and a counter. The unit has been successfully tested and is recommended for production. Figures 1a, 1b, 2, 3.

[296-12497]

## 'TSIFRA 101' DIGITAL TIME CORRECTOR FOR 'C' FORMAT VIDEORECORDERS

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 84 pp 46-52

GERGEL', O. A. and SHTEYN, A. B.

[Abstract] "C" format videorecorders with the field recorded in one line are subject to time distortion because of differential movements of heads and tapes when recording and regenerating. The "Tsifra 101" corrector was created in order to remove distortions in the spectrum of several Hz to several kHz and from nanoseconds to several microseconds and capable of affecting around 6.5 image lines. For correction, the videosignal must be digitized and the pulses processed in a phase-frequency control system which generates a reference pattern, compares and corrects. The unit consists of converters, a memory unit, pulse generators and a control unit. Corrections of errors attaining 3 microseconds (maximum error in a single image line) are possible and the 4096 bit memory is large enough to cope with 16 TV lines. The unit is intended for Kadr-103AS type C format videorecorders for SECAM signals. A difficulty consists of inadequate quantizing so that standard TV signal testing does not always give good results and it is suggested that coding be raised from 8 to 9 or 10 bits. The unit has been successfully tested and is recommended for production. Figures 8, tables 1, references: 1 Russian, 1 Western.

[296-12497]

UDC 778.588.8:771.537.62

## IMPROVING READABILITY OF TITLES AGAINST ACTION BACKGROUNDS

Moscow TEKNIKA TELEVIDENIYA in Russian No 6, Jun 84 pp 57-60

VOLOKUSHIN, V. G. and DRUTSKOY, O. V., "Lenfilm" Film Studio

[Abstract] Titles on movie films are often unreadable against action backgrounds and legibility can be improved by increasing brightness contrast at the letter margin. However, if the film is in color, increasing brightness can mean the appearance of haloes while brightness reduction decreases effectiveness. The solution is to create an unexposed zone at the letter-background margin by means of masks in letter form producing a protected area, but the lines may not be thick enough. Mechanical optical processes for mask making involve rotating or translating the original and the Lenfilm' studio has created the RKU-300 rotary copying unit for 1:1 reproduction of enlarged line masks consisting of an optical light transmission system with a rotary head containing adjustable eight position optical wedges for enlargement with a red filter shutter. The optical head is mounted on a base containing the rest of the system and a console. The device with dimensions of 840 x 420 x 1630 mm has been successfully used for several films. Figures 4, references: 4 Russian.

[296-12497]

UDC 621.3.011.7

NOISE IN STAGES AND IN INTERSTAGE COUPLINGS OF VARIOUS TRANSISTOR CIRCUITS

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received, after completion, 16 Jul 83) pp 23-27

TERPUGOV, N. V.

[Abstract] For the design of high-sensitivity low-noise transistor devices, the overall noise level and the spectral noise power density are calculated on the basis of the equivalent noise generator and y-parameters corresponding to the three fundamental transistor circuit configurations: common-emitter (common-source), common-collector (common-drain), common-base (common-gate). The equations are first solved exactly and then approximately. An evaluation of the results indicates that the approximate solution yields the sought noise characteristics with a degree of accuracy adequate for engineering purposes. The method of calculations is easily extended to combinations of transistor stages such a common-emitter/common-emitter pair or a common-emitter/common-collector pair. Figures 4; references: 5 Russian.  
[301-2415]

UDC 621.391.1:621.391.81

PROBABILISTIC ANALYSIS OF AUTOMATIC CONTROL SYSTEMS FOR DETECTION SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 5, May 84 pp 36-37

[Annotation of article deposited at Central Scientific and Technical Institute 'Informsvyaz'', No 299]

KAZAKOV, D. L., SHANAYEV, O. K. and ZHURAKOVSKIY, V. N.

[Abstract] Automatic adaptive detection systems with digital signal processing are considered, consisting of a threshold device and a digital decision device with a feedback loop which includes an n-bit reversible counter, a logic analyzer, an n-bit shift register, and a digital-to-analog converter. For constructing the transfer probability graph, it is proposed to consider not only the main states but also the complementary states of the shift register. The corresponding method of determining the elements of the transfer

probability matrix  $\|\pi\|$  is demonstrated on the case of  $n=3$  and  $k=1$ . This method is shown to be applicable to probabilistic analysis of such systems with either stationary or nonstationary input processes, but the connectedness of the Markov chain must be accounted for and properly approximated in order to avoid unacceptably large errors. Figures 1.  
[301-2415]

UDC 621.391.83.088:681.513.7

# HIGH-SPEED ADAPTATION ALGORITHM FOR HARMONIC CORRECTOR

Moscow RADIOTEKHNICA in Russian No 5, May 84 (manuscript received, after completion, 28 Nov 83) pp 41-44

MIKHAL'CHAN, V. S.

[Abstract] A transversal filter of finite length acting as a harmonic corrector is used in various communication systems for compensation of linear intersymbol frequency distortion and thus an increase of the data transmission rate or channel capacity. An important factor is reducing the corrector adaptation time, which requires a special high-speed algorithm for regulating its controllable parameters. Such an algorithm can be constructed in accordance with the theory of computation complexity, the object being to devise an algorithm which is economical. A new second-order iterative algorithm for automatic tuning of the corrector with a sequence of single probing pulses is shown to be a fast converging one, capable of regulating the corrector parameters in approximately 25% less time than conventional second-order iterative algorithms. Designed for a single-stage nonrecursive harmonic corrector, this algorithm is  $c_i(n+1) = c_i(n) - \alpha(n) \langle r_i(n) \rangle - \beta(n) \langle r_{-i}(n) \rangle$  ( $c_i$  - controllable parameter,  $i = -N, \dots, N$ ,  $\langle \rangle$  averaging in time for suppression of additive noise,  $n = 0, 1, 2, \dots$  consecutive number of an iteration,  $\alpha(n)$  and  $\beta(n)$  initially arbitrary and later optimizable convergence parameters,  $r_i = a_i - a_i^*$  \* deviation of signal readings  $a_i$  at corrector output from required signal readings  $a_i^*$ ). The two convergence parameters are optimized by simultaneous solution of the system of two linear equations for the mean-square error of corrector readings. A digital harmonic corrector of intersymbol distortion with automatic tuning of its controllable parameters  $c_i$  has been synthesized on this basis. With  $i=13$  ( $N=6$ ) and assuming two levels of linear distortion in the transmission channel, it was adaptively tuned according to this algorithm and corresponding "adaptation curves" in as short a time as expected. Figures 2; references 5: 4 Russian, 1 Western (in Russian translation).  
[301-2415]

## ADAPTIVE CORRECTOR OPERATING IN FREQUENCY DOMAIN

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received, after completion, 21 Nov 83) pp 47-49

RADIKAYNEN, Ya. M.

[Abstract] An interference-immune corrector for a signal converter with automatic regulation of adaptation speed is described which operates in the frequency domain with fast convergence and high signal-to-noise ratio. It contains an analog-to-digital converter, a demodulator, and a filter array with equidistant spacing of center frequencies, three multipliers and two summators, as well as a reference signal generator, a frequency divider, a counter, and a noise meter. Filtering can be done by means of a  $n$ -point Fourier transformation or bunching with a memory at the filter input followed by inverse Fourier transformation or debunching, respectively. The algorithm of corrector operation in the frequency domain can be constructed heuristically by analogy to the complex algorithm of minimizing the mean-square error in the time domain. Each weight factor can be processed independently and only once per Fourier transformation cycle, which ensures fast convergence without preliminary phase correction even with large distortions in the communication channel. Figures 2; references 9: 8 Russian, 1 Western (in Russian translation).

[301-2415]

UDC 621.391

## TRANSFORMATION OF SPECTRUM OF PHASE-CODE KEYED SIGNAL FOR SCANNING IN TIME

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received 28 Dec 82) pp 60-61

MAKSIMOV, Ye. R.

[Abstract] Use of phase-cycle keyed signals improves the time resolution of various radio engineering devices, combined correlation analysis and filtration being the optimum method of processing such signals. A technically simple way to scan such a signal in time is by shifting the clock frequency and correspondingly the phase in the reference signal relative to those in the received signal. The procedure is demonstrated mathematically for the important case of periodic keying with the multiplier in the receiver followed by an array of intermediate-frequency filters, because such a shifting gives rise to additional harmonic components symmetric with respect to the intermediate frequency in the spectrum. From the relation for the amplitude of the high-frequency voltage with a  $\frac{\sin x}{x}$  envelope of the keying pulse sequence the maximum scan rate is obtained without loss of sensitivity at some given carrier frequency, this scan rate being equal to the difference between the keying pulse repetition rates in the received signal and in the reference signal, respectively. Figures 1; references: 1 Russian.

[301-2415]

## DIGITAL MATCHED FILTER

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received 18 Oct 83)  
pp 82-83

ARZUMANYAN, Yu. V. and RAYKHLIN, A. Kh.

[Abstract] Synthesis of a digital passive filter with integrated microcircuits and rigid logic is shown which yields a matched device less intricate with fewer microcircuits than existing ones. The filter computes the correlation function of the input signal from  $2N$  readings in a part of the input signal of  $2T$  duration ( $T$ - duration of signal packet,  $N$ - number of independent readings), which are stored in memories, and forms  $N$  signal realization of duration  $T$  differing from one another by a shift per reading. Each of these  $N$  realizations is multiplied by a reference signal of duration  $T$  and the product is integrated, which yields the discrete correlation function of the input signal. The structure of such a digital matched filter includes two  $2N$ -bit memories in push-pull, a commutator, a multiplier, a reference-signal generator, a summator with an accumulator-register, and a control module for read-in and read-out addressing as well as for driving the commutator and the reference-signal generator. A filter for an  $M$ -sequence of 511 elements with an 8-bit input signal requires only approximately 120 microcircuits in 256-bit memories. Figures 1; references: 2 Russian.

[301-2415]

UDC 681.328.8

## HARDWARE REALIZATION OF DIGITAL FILTERS WITHOUT MULTIPLIERS

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received 27 Sep 83)  
pp 83-86

BRUNCHENKO, A. V., VLASYUK, Yu. S. and IGNAT'YEV, A. A.

[Abstract] A method of constructing digital filters is proposed, elimination of multipliers being possible when there are only a few "1" elements in the code of coefficients. Multiplication is effected by a simple shift of the code through the corresponding number of digits in the direction of lesser significance. The hardware includes registers, multi( $p$ )-input adders ( $p-1$  plain 2-input adders), sign reversers, shifters acting as 2- $j$ -multipliers, and a commutator in the form of an AND-OR logic element. The interconnections are determined by the algorithm, they can be designed for either parallel or sequential processing of signals. In both modes the speed is determined by the minimum repetition period of register synchronizing pulses and the latter is equal to three time delays: in a register, in an adder, and in the commutator. The output noise caused by the finite length of registers, assuming the errors of each source to be noncorrelated, has a zero mean and a dispersion which depends on whether rounding is done after the adders or after the registers. Figures 5; references: 2 Russian.

[301-2415]

## DESIGN OF HIGH-ORDER ANALOG AND DIGITAL FILTERS WITH IDENTICAL SECTIONS

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received 28 Sep 83)  
pp 87-90

GREBENKO, Yu. A., SAVKOV, N. N. and SEMKIN, A. A.

[Abstract] The method of synthesizing high-order active filters with identical functional components is extended to analog and digital filters. All sections are assumed to be canonical ones of the kind and with frequency characteristics corresponding to those of the composite device, their maximum transfer ratio being equal to unity. The necessary calculations are facilitated by tables of parameters which yield the cutoff frequency, the center frequency, the pass or stop band, and the coefficients of the transfer function for low-pass, high-pass, band-pass, and band-elimination filters--all based on a low-pass prototype section. The procedure is illustrated in two ways: calculation of forward and backward transmission coefficients of an analog third-order Butterworth filter and design of a digital seventh-order Butterworth band-pass filter. Figures 3; tables 2; references 4: 2 Russian, 2 Western (1 in Russian translation).  
[301-2415]

## STATE OF ART AND DEVELOPMENT PROBLEMS IN COMPUTER-AIDED DESIGN OF ELECTRONIC CIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 13 Feb 84) pp 7-17

IL'IN, V. N.

[Abstract] The present third-generation software for computer-aided design of electronic circuits is based on implicit schemes for calculation of transients with stepwise numerical integration of differential equations according to Newton and Gauss algorithms or their modification, on matrix sparsity in simultaneous solution of systems of linear algebraic equations, on use of list forms for matrix representation, and on Monte Carlo or statistical test methods for statistical analysis. Programs are now available for modeling electronic circuits at the MSI level and simulating processes in them, written for YeS-1033 and YeS-1065 computers. They still cannot handle LSI circuits, except by breaking them down into fragments with the engineer's aid. Accordingly, the next step in development of computer-aided design systems will be raising their capability to LSI and VLSI levels with adequate speed and accuracy. The necessary hardware can consist of either microprocessor arrays with function expanders, or special-purpose computer LSI with rigid logic, or built-up conventional computer hardware. The fourth-generation software must be problem-oriented and include debugging procedures,

with full mastery of the input language and automatic model selection. Finally, computer-aided design systems must be made more flexible for a broader range of applications and this requires, among others, an adequate degree of standardization and of reliability assurance. The most prominent existing foreign software for computer-aided circuit design are SPLICE and DIANA, their Soviet counterparts being ELAIS-82 (Moscow Institute of Engineering Physics), PA-6 (Moscow Higher Technical School), SPROS and APROS-1 (Moscow Institute of Aviation). There are several obstacles to a faster adoption and more extensive use of computer-aided design systems, the six major ones being: 1) insufficient algorithmic reliability of programs (insufficiently high probability of obtaining a complete and correct design); 2) inadequate capability of program relative to practical design requirements; 3) inadequate software management and maintenance by enterprises; 4) inadequate documentation and circulation facilities, especially in higher educational institutions where programs are being developed; 5) lack of standardized information bases available to all; 6) nonsystematic approach to adoption and use of computer-aided design systems. These problems will have to be tackled within the development program, which must also include training of specialists in computer-aided design. References 28: 24 Russian, 4 Western (3 in Russian translation).  
[305-2415]

UDC 621.372.061

# MODELING OF ELECTRONIC CIRCUITS WITH HIGH DEGREE OF COMPONENT INTEGRATION (State of Art and Outlook)

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 6, Jun 84 (manuscript received 27 Jan 84) pp 17-31

FROLKIN, V. T., TIKHOMIROVA, Ye. M. and MOSHNYAGA, V. G.

[Abstract] There are now computer programs available for analyzing the static and dynamic performance of LSI circuits by simulation, calculating their frequency characteristics, and determining the external influence factors--all within 99% accuracy. They are essentially based on Kirchhoff's laws and corresponding systems of equations. With the trend continuing toward VLSI, it is not sufficient to increase the computer capacity and speed but it is also necessary to develop more efficient new methods and algorithms. These are preferably based on macromodels rather than built-up conventional models. Logic macromodels relate events in time sequence, electrical macromodels relate currents and voltages. Hybrid logic-electrical models offer the advantage of internal coupling between levels, which facilitates straight-through simulation with already existing programs of computer-aided design. Tradeoff between maximum accuracy and minimum complexity can be achieved by simplification, either through judicious elimination of components or through contraction of the system of equations. In view of the fact that only 0.01-10% of all circuit elements participate in any one switching event, time-sequence algorithms of simulation are constructed which incorporate the

concepts of activity and latency. Software extensively used for macrosimulation of LSI and VLSI circuits are the for eign SPICE-2, SLATE, SPLICE, MACRO, SAMSON, MOSTAP, MATIS, MOTIS-C and the Soviet SPROS. A second approach to computer-aided design and performance analysis of LSI and VLSI circuits with best tradeoff between accuracy and speed is mixed simulation particularly applicable to hybrid digital-analog circuits, and a third approach is multi-level simulation with either mixed simulation or a specific form of analysis at each level as in SABLE and VISTA software. Figures 10; tables 2; references 65: 20 Russian, 1 Polish, 44 Western (2 in Russian translation). [305-2415]

UDC 681.142.36

#### BASIC FEATURES OF PERSONAL COMPUTERS

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 6, Jun 84 (manuscript received 2 Dec 83) pp 32-37

JAN, J. (Jiri), candidate of technical sciences, docent, engineer, Chair of Medical Electronics, Higher Technical School, Brno (CSSR)

[Abstract] Personal computers essentially consist of a simple microprocessor, input and output devices, a clock-frequency generator, and a memory. The basic computer capabilities, namely word length and speed, are determined by the clock-frequency generator. Pocket and desk computers are the simplest ones, with a 4-bit microprocessor, but are also correspondingly slow and short. Increasing the word length to 16 bits and the speed correspondingly or increasing the memory capacity involves an increase of the cost. Most microprocessors, memories, and auxiliary peripheral devices are built on the basis of N-MOS or C-MOS technology, programming and reprogramming modules are built with TTL circuitry. The basic input device is a keyboard, the choice of type usually determined by its cost relative to total computer cost and ranging from inexpensive membrane arrays in general-purpose computers to more intricate and reliable ones in professional models. The basic output device is a display, most often incorporating a cathode-ray tube. Special features are data storage in external memories, on magnetic tape or on paper. Data converters, analog-to-digital or graphic-to-numeric can be added for solution of scientific problems, processing of experimental data, or games. The computer software consists of producer's general programs stored in the read-only memory and user's special programs stored in the direct-access memory. Most programs are written in BASIC, but many scientific and engineering problems require a procedure-oriented high-level language such as PASCAL, FORTRAN, COBOL or LISP, LOGO, FORTS. Personal computers now on the market fall into three broad classes: 1) lowest-grade pocket models (e.g., PC-1211 and PC-1500 produced by Sharp) and desk models; 2) intermediate-grade standard models (e.g., ZX produced by Sinclair); 3) highest-grade professional models (e.g., series 200 model 16 produced by Hewlett Packard). Existing models are likely to become obsolete in the process of rapidly occurring developments. [305-2415]

## ADAPTIVE MODELING OF ELECTRONIC CIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 12 Dec 83) pp 37-41

NORENKOV, I. P. and SOMOV, P. A.

[Abstract] Complete models on the circuit level are not sufficient for analysis of LSI and VLSI systems, which has necessitated development of multi-level algorithms and programs. Adaptive simulation with automatic interchange of model fragments and calculation processes is one such possibility. It is based on assuming that the system consists of standard fragments for which macromodels are already available, on using unidirectional macromodels with the state of the input stage not dependent on the state of the output stage, and on first selecting a model intermediate between the complete model and the macromodel of first-level complexity. Adaptive simulation begins with determining the initial conditions, using efficient algorithms of repetitive iteration on a fixed  $[0, t_1]$  time interval. It subsequently requires twofold fragmentation, namely a functional one into standard fragments with an available macromodel library and a diakoptic one into independently integrable fragments. Such a fragmentation must be error-free, especially when done by the approximate relaxation method, as demonstrated on a fundamental series chain of standard fragments and on an intricate modulo-2 convolution circuit with transistor-transistor logic. Figures 4; references 5: 1 Russian, 4 Western.  
[305-2415]

UDC 681.5.015.23

## DIAKOPTIC CALCULATION OF CHARACTERISTICS FOR OPTIMIZATION OF LINEAR CIRCUITS WITH RESPECT TO PARAMETERS OF INDIVIDUAL BRANCHES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received, after revision, 2 Jan 84)  
pp 51-56

GODLEVSKIY, V. S., KISELEV, V. A. and LEVITSKIY, V. G.

[Abstract] The method of multistep subcircuits is applied to multivariant optimization of linear circuits with respect to sensitivity. The corresponding algorithm of diakoptic design and performance calculation involves extraction of all two-pole branches containing variable parameters into a separate higher-level additional subcircuit. The efficiency of this algorithm is shown to increase with decreasing ratio  $r/q$  ( $r$ - number of nodes to which two-pole branches with variable parameters are connected,  $q$ - total number of nodes in circuit), which is particularly significant in the case of electronic circuits with  $r/q \ll 1$ . The three canonical kinds of extracted  $t$ -th two-pole

branch are: 1) one connected to two internal subcircuit nodes; 2) one connected to a boundary node and an internal node; and 3) one connected to two boundary subcircuit nodes. The corresponding subsystem of vector equations for the node voltages is easily constructed by the Gauss method of block-wise elimination and then transformed into a system of partial differential equations, the latter solvable with the use of impedance or admittance matrices. The algorithm was used in parametric optimization of frequency-domain corrective networks for operational amplifiers, specifically a three-stage amplifier with 65 nodes and 182 branches. After partition into 16 subcircuits, amplitude and phase of the output signal were calculated on a YeS-1022 computer in 0.8 s for each frequency. References: 5 Russian. [305-2415]

UDC 621.382.82.001

#### ALGORITHMS AND ORGANIZATION OF SOFTWARE FOR COMPUTER-AIDED CIRCUIT DESIGN

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 6, Jun 84 (manuscript received 12 Dec 83) pp 71-77

NORENKOV, I. P., MARTYNYUK, V. A., TRUDONOSHIN, V. A. and FEDORUK, V. G.

[Abstract] A new software PA6 has been developed for computer-aided design of electronic LSI circuits, the two main objectives being to minimize machine time for circuit analysis and to ensure long-range viability. The underlying mathematical model of an electronic circuit is a system of algebraic and differential equations for node potentials  $\Psi(\dot{x}, x, t) = 0$ , solvable either by the implicit Euler method or according to a combination implicit-explicit scheme of second-order accuracy. Nonlinear equations of the  $F(x) = 0$  kind are solved by the Newton method with LU-expansion of the system of linear algebraic equations in  $Ax = B$  matrix form. The algorithm involves fragmentation followed by separate iteration within fragments having different degrees of nonlinearity and simultaneous logic-electrical analysis. Incorporation of the latency concept saves machine time, inasmuch as passive circuit fragments are readily identified and their variables temporarily eliminated from the original mathematical model. The internal language consists of two sub-languages, a structural one describing the object (equivalent circuit) with use of FORTRAN for functional relations and a procedural one describing the required computer operations (calculation of steady state, calculation of transient processes, establishment of initial conditions, preservation of analyzed circuit, multivariant analysis, parametric optimization). The principal part of the hardware is a compiler of object modules consisting of an analyzer, a generator, and a constructor. The active volume of the direct-access memory is regulated diakoptically, programs and subroutines are initiated and controlled by INCLUDE and OVERLAY statements. In the PA6 library are already filed more than a hundred models of electrical and logic devices, macromodels, and models of nonelectrical objects. Subroutines, in addition to the two aforementioned methods of numerical integration, include calculation of performance parameters, calculation of nominal requirements and tolerances, multivariant and statistical analysis, and parametric optimization. Figures 2; references 8: 4 Russian, 4 Western. [305-2415]

## ART OF PROGRAMMING PROGRAMMABLE MICROCALCULATORS: CALCULATION OF RESPONSE FROM CURRENT VALUES OF ACTION

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 21 Oct 83) pp 78-84

TROKHIMENKO, Ya. K.

[Abstract] Programmable microcalculators can be programmed for the solution of engineering problems such as calculating the response of an object to a given action. This problem is to be treated as one of cause-effect relation in the time domain  $y(t) = \alpha x(t)$  and reduced to a calculation of the coefficient  $\alpha$ , the latter simulating the properties of the material object which constitutes the channel between input action  $x$  and output response  $y$ . In the simplest case this channel is linear so that coefficient  $\alpha$  remains constant and independent of the input level. More generally it is nonlinear and it becomes necessary to solve nonlinear ordinary differential equations, or extraneous actions interfere so that coefficient becomes a function of time and it becomes necessary to solve the Cauchy problem for nonhomogeneous ordinary differential equations with known initial conditions and with energy storage as well as finite rate of energy transfer taken into account. The microcalculator solves differential equations by the numerical method of finite differences, the algorithm generally involving a Laplace transformation from function of time to a fractional-rational function of complex frequency and approximation of the latter with a power polynomial. Program 1/34 is designed to solve a linear difference equation representing an ordinary differential equation of order  $n = 4$  in the output (response) variable  $y$  and of order  $m = 3$  in the input (action) variable  $x$ , as for a simple RLC circuit. Program 2/34 is designed to simulate the performance of a diode-type detector or a amplifier. Program 3/34 is designed to simulate the performance of a harmonic or quasi-harmonic oscillator. Program 4/34 is designed to simulate the behavior of a more complex oscillatory system such as a ship with variable-thrust engine moving on water with velocity-dependent resistance according to Newton's law. The convergence of the computation process is most easily checked against the solution for a standard action such as a unit step with known analytical solution to the corresponding differential equation. Figures 1; references 7: 6 Russian, 1 Western (in Russian translation).  
[305-2415]

UDC 621.382.82.001

## COMPUTER SIMULATION OF INTEGRATED INJECTION LOGIC

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 11 Aug 83) pp 85-86

MIKHAYLOVA, O. M. and PETROSYANTS, K. O.

[Abstract] Computer simulation of integrated injection logic on a bipolar VLSI basis is proposed which takes into account the distinct parametric and circuit features of such a logic as well as the functional integration of its components. Conventional fragmentation into vertical n-p-n and horizontal p-n-p

pairs of interconnected separate transistors as a model of an  $I^2L$  element is not most expedient, because of software complexity and an excessive amount of machine time. The advantages of the proposed method are made evident on the classical example of a bistable injection trigger cell produced by epitaxial-planar technology for LSI digital and memory  $I^2L$ . Performance analysis by simulation is possible here with three ways of representing such a cell: 1) as an array of four separate transistors with eight p-n junctions (two per transistor); 2) as an array of two  $I^2L$  elements formalized in program modules with six p-n junctions (three per element); 3) as a self-contained circuit element formalized in a separate program module with fewer than five p-n junctions, because of the injector region being common to both  $I^2L$  elements. The machine time saved is 25% with the second variant and 38% with the third variant, a saving of 150-200% being feasible as the circuit complexity increases appreciably. Figures 1; references 5: 4 Russian, 1 Western. [305-2415]

UDC 621.382.2

#### NUMERICAL SIMULATION OF NONISOTHERMAL TRANSIENT PROCESSES IN GaAs DIODE STRUCTURES

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 6, Jun 84 (manuscript received 28 Feb 83) pp 86-88

VELMRE, E. E. and FREYDIN, B. P.

[Abstract] A model is constructed for analysis of nonisothermal transient processes following a strong sinusoidal half-wave pulse of millisecond duration in a rectifier on a GaAs semiconductor structure between two conductor plates with an arbitrary number of different metal interlayers. The model is based on the system of partial differential equations of a semiconductor and the equation of heat conduction, self-consistently solved in the one-dimensional approximation. Both nonradiative and radiative components of recombination are included, the former according to the Shockley-Reed-Hall mechanism, with the temperature dependence of mobility and all coefficients in the expressions for the two recombination rates taken into account. Mobility and diffusion coefficient are related according to the Einstein equation. The boundary conditions for hole and electron concentrations are determined from the conditions of electric neutrality and thermodynamic equilibrium. The boundary conditions for heat conduction at the edge of the semiconductor structure have been established for a strong direct-current pulse. Numerical solution of these equations has been programmed in FORTRAN-4. Calculations were made for a 150  $\mu\text{m}$  thick  $p^+-p-n-p^+$  GaAs film between two 2.5 mm thick Cu plates with four 50  $\mu\text{m}$  thick Au interlayers and two 250  $\mu\text{m}$  thick W or 50% Ni - 50% Fe interlayers. Figures 2; references 3: 1 Russian, 2 Western. [305-2415]

## MODELING OF DISCRETE DEVICES WITH USE OF MULTIVALUED LOGIC AND NOMOGRAMS

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received, after revision, 12 Nov 83) pp 88-89

MOLCHANOV, A. A., MAKAROV, S. M. and TELOT, Kh.

[Abstract] Multivalued logic models, most appropriate for accurate analysis of discrete devices with time delays and their dynamics, are also suitable for calculating their static characteristics. A special model has been developed for multipass simulation of steady-state processes in such devices using the discrete analog of the Seidel method, with logic "1"'s and "0"'s replaced by some ranges of discrete values. Steady-state values of the outputs do not depend on statistical deviations of values of the input vector components from standard "1" or "0" values as long as these deviations do not go beyond those preset ranges. Nomograms for calculating the time delay at each output, as function of the load across the corresponding component, have been included in the software. The speed of simulation can be increased by also including lookup tables. Figures 1; references: 4 Russian.  
[305-2415]

UDC 681.3.06:629.8.049.77.029.64

## SOFTWARE FOR FREQUENCY ANALYSIS OF MICROWAVE CIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 5 Dec 83) pp 94-95

KARPUKOV, L. M.

[Abstract] Software for analysis of integrated microwave circuits on microstrip lines is designed for calculation of the scattering matrix in the frequency domain, calculation of the sensitivity function, byte analysis, and parametric optimization. It is based on description of basic elements in terms of electro-dynamic parameters, it is written in high-level FORTRAN-4 language without need for low-level language, its structure is modular, and it is formulated for maximum versatility. Coefficients of the scattering matrix are calculated in the single-mode approximation according to a cyclic algorithm with recurrence relations for series chains of multipole networks. Byte analysis involves resolution of scattering parameters of a circuit with respect to parameters of its basic elements. Parametric optimization proceeds with respect to an additive target function which is a weighted sum of partial target functions. The relatively small number of different basic elements facilitates efficient running of the programs without sacrifice in versatility. Execution of the programs on a YeS-1022 computer has confirmed that these programs are simple, reliable, and use machine time economically.  
[305-2415]

## SYSTEM FOR COMPUTER-AIDED DESIGN OF ANALOG ELECTRONIC CIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 6 Jan 84) pp 95-96

TROKHIMENKO, Ya. K., LOVKIY, V. K., YASTREBOV, N. I. and GREBEN'KOV, N. V.

[Abstract] PAKTOR-1A is a system for computer-aided design of analog electronic circuits as well as for calculation of their static and dynamic performance, including stability analysis, and calculation of their operating, frequency, and time characteristics during the initial design stage. The software has a modular structure. Included is a correctible library containing models of linear and nonlinear active circuit components. The input language is formulated for running the program in the dialog mode, with symbols as  $C12 = 10pF$  and  $T2 = KT315$  for passive and active element respectively, the algorithmic language is PL-1. The software yields steady-state voltages, currents, and power, frequency characteristics with uniform or variable frequency steps, transient and pulse response characteristics calculated by means of inverse Laplace transformation, and a stability analysis, either on the basis of the Hurwitz criterion with expansion into a continued fraction or on the basis of frequency holograms. Optimization procedures can be added for target-oriented variation of circuit parameters. References: 3 Russian. [305-2415]

## OPTIMIZATION OF RADIOELECTRONIC CIRCUITS WITH SOFTWARE FOR MODELING OF INTEGRATED CIRCUITS ON 'UNIFIED SYSTEM' COMPUTER

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 17 Mar 83) pp 97-98

KATSNEL'SON, L. Z., KEL'MAN, Ye. S. and POKHVALINA, L. S.

[Abstract] Software for modeling integrated circuits on a YeS computer and subsequent design optimization of radioelectronic devices according to the criterion of minimum capacity margin is available which covers steady-state performance and frequency characteristics separately or together. Modified Ebers-Moll equations with the Early effect serve as the model of a transistor. The optimization problem is solved by the method of discrete maximin with steepest descent. The software, consisting of over 300 programs written in FORTRAN, can handle up to 80 transistors, 170 nodes, and 540 two-pole networks. It consists of 11 modules: 1) SAKS data input; 2) OPTIM optimization; 3) STREPE analysis and calculation of independent variables for SLUP matrix with column of free terms; 4) SPR 2 calculation of SLUP matrix elements; 5) GAUSS inversion of SLUP matrix and program interruption in case of error; 6) STATIE stipulation of independent power sources; 7) FUNMIN numerical solution of steady-state problem by various methods; 8) SPRIGHT solution of

nonlinear steady-state equations; 9) SOLS printout of steady-state output characteristics, if required; 10) GALS calculation of output parameters, functionals, and capacity margins with printout of static characteristics, if required; 11) NOISEACA calculation of frequency and noise characteristics with printout of output parameters, functionals, and capacity margins, if required. Figures 1; tables 1; references: 4 Russian.  
[305-2415]

UDC 621.396.6.001.63:681.3.06

#### DIALOG SYSTEM WITH MINICOMPUTER FOR PLOTTING PERFORMANCE CHARTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 23 Jan 84) pp 99-100

NOSIKOV, S. P. and FROLKIN, V. T.

[Abstract] Plotting performance charts is part of the documentation needed for validating the design of radioelectronic devices. There is also a need for plotting such charts automatically so as to ensure the necessary accuracy and reliability as fast and as frequently as possible. A dialog system for chart plotting has been developed to serve this purpose, which uses a standard SM-4 on-line minicomputer with a direct-access memory of 32,000 words capacity and with minimum peripheral equipment, the latter including only a video terminal, and alpha-numeric printer, and a magnetic-disk storage. The software is flexible and adjustable with a modular structure, consisting of universal programs applicable to all kinds of charts and a special data base where distinctive features of each performance chart are filed. The four separate programs written in FORTRAN are KRR1 for composing lists of circuit elements, KRR2 for requesting and receiving user's specifications, KRR3 for revision, only if necessary, and KRR4 for breaking up the array of data lines into parts to which lines from the data base are added to produce together ready 290x330 mm<sup>2</sup> chart sheets. The data base contains at this time descriptions of charts for six categories of devices (resistors, capacitors, inductance coils and chokes, plugs and sockets, quartz filters) as well as technical specification on 114 items in less than 50 kilobytes. One magnetic disk has a 2.4 Mbyte capacity and thus enough space to accommodate charts and technical data on approximately 1000 items. Figures 1; references: 2 Russian.  
[305-2415]

UDC 681.3:621.372.061

#### ALGORITHMS FOR CONSTRUCTING MODELS OF CIRCUIT ELEMENTS IN INPUT LANGUAGE OF COMPUTER-AIDED DESIGN SOFTWARE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 26 Dec 83) pp 100-102

KOGAN, V. L., USKOV, V. L. and BELOTSEKOVSKIY, A. S.

[Abstract] A method of modeling a new device or circuit element with computer-aided design software is proposed, namely writing the analytical expressions

which describe it in the input language. Two types of analytical models are considered, universal ones and modifiable ones. In each case the corresponding mathematical equations are put in a form suitable for integration by implicit schemes. The procedure is demonstrated on a scalar equation for current  $i$  as a function of voltage  $v$ , time  $t$ , and rate of change of voltage  $i = f(v, \dot{v}, t)$ . The algorithm of solving such an equation involves replacing the time derivative of voltage with its difference analog and solving the resulting equation numerically, by the Newton iteration method. The procedure is somewhat different for universal and modifiable models, considering that the former is completely describable in the input language while in a latter only some parameters are given as functions of time or space coordinates.

References: 1 Russian.

[305-2415]

UDC 681.32:519.1

#### ALGORITHM FOR DETERMINATION OF ISOMORPHIC GRAPHS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received, after revision, 9 Jun 83) pp 102-103

RUZAYEV, Ye. N.

[Abstract] An algorithm is proposed for determination of isomorphic graphs in the analysis and synthesis of standard arrays of modules or subsystems. It is particularly effective in the case of nonoriented graphs with sparse contiguity matrices. There are 13 steps and 5 loops between start and stop, including one tabulation, for finding vertices and paths. The number of computing operations lies between  $O(n)$  and  $O(n!)$ , pathfinding being simplified by use of modulo-2 scalar-vector products of symbols over the field.

References: 3 Russian.

[305-2415]

UDC 621.391

#### METHOD OF ESTIMATING CONVERGENCE OF HAAR COEFFICIENTS IN MESSAGE COMPRESSION PROBLEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 6, Jun 84 (manuscript received 19 Sep 83) pp 103-104

SOBOLEV, Yu. V., POLYAKOV, P. F. and IVANOV, V. G.

[Abstract] The conventional method of estimating the convergence of a truncated Haar series, namely calculation of its coefficients and subsequent restoration of the original message on their basis by equating some of them to zero while adding the squares of differences between original and restored values, involves an unwieldy orthogonal transformation and estimation of its

error. The process can be simplified by discarding the tentative last coefficient in the series and replacing the next pair of originally read values with their average. The error is then calculated as the sum of the squares of differences between these two values and their average, whereupon the next tentative last coefficient is discarded and the procedure is repeated. The respective two errors are compared and the procedure is continued till the error becomes acceptable. Estimates of the numbers of operations, additions or subtractions and multiplications (division by an integer being negligible) as well as of the corresponding computer time and the transformation error indicate that, in a typical case of a compression coefficient of 2 and a Haar series with 16 coefficients, this method can be up 10 times more efficient than direct calculation and almost twice as efficient as with error estimation by known fast algorithms. Figures 1; references: 2 Russian. [305-2415]

UDC 681.3:681.5.072

# DETERMINATION OF SENSITIVITY FUNCTIONS FOR DISCRETE DYNAMIC SYSTEMS FROM RESULTS OF FUNCTION MODELING ON DIGITAL COMPUTER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 6, Jun 84 (manuscript received 19 Dec 83) pp 105-106

GLUSHANKOV, Ye. I., DAVYDENKO, V. V. and THERENT'YEV, V. M.

[Abstract] The sensitivity function  $\partial \gamma / \partial p$  characterizing the performance of a discrete dynamic system, namely the response of its performance indicator  $\gamma$  to change in the variable model parameter  $p$ , is calculated by differentiating  $\gamma(p)$  with respect to  $p$ . This requires expressing the function  $\gamma(p)$  in an analytical form, which can be done according to the Lagrange interpolation rule with use of a power polynomial at the nodes. The algorithm, consisting of seven steps and one loop between start and stop, solves the sensitivity problem as an optimization problem with the appropriate functional as optimality criterion. It is demonstrated on a multidimensional linear filter which extracts the useful signal from a mixture of background interference and perturbation noise, the latter describable as a white random sequence. As optimality criterion for  $\gamma$  in this case serves the ratio  $Sp[V_{\tilde{x}}(\infty)]/Sp[V_{\tilde{x}}(0)]$  or preferably the ratio  $Sp[V_{\tilde{x}}(0)]/Sp[V_{\tilde{x}}(\infty)]$  with simpler interpolation and calculation of derivatives ( $V_{\tilde{x}}(0)$  - initial dispersion of estimation error,  $V_{\tilde{x}}(\infty)$  - final steady-state dispersion of estimation error). Such a problem can be solved by this method in real time and without complication of the program. Figures 2; references 6: 5 Russian, 1 Western (in Russian translation). [305-2415]

UDC 621.372.22.001.24

ANALYSIS OF CROSSTALK IN NONHOMOGENEOUS MULTI-CONDUCTOR LINES

Moscow ELEKTRICHESTVO in Russian No 5, May 84 (manuscript received 28 Jul 83)  
pp 40-42

ORESHNIKOV, V. G. and SHAPOSHNIKOV, A. S.

[Abstract] Multi-conductor crosstalk is caused by interconductor electromagnetic and static induction and resistance and is determined by primary line parameters. The currently used model and phase methods for line modes are applied for particular modes but cannot analyze random load line operations because receiver resistance must be matched with the continuous telegrapher equation lines while known iterative methods converge slowly to the boundary conditions and require considerable computer time expenditure. Analysis is more difficult for nonhomogeneous multiconductor modes because the differential or difference equations have variable complex coefficients. A method is given based upon a transition from line equations with particular differentials to approximating difference equations, i.e., to discrete line models. The method makes it possible to determine effectively modes for different boundary conditions and reduces nonhomogeneous multiconductor modes to elementary operations on low order matrices. Computer procedure is simplified by special features of the general matrix so that programming is improved and machine time reduced. Examples are given. Figures 2; tables 2; references: 4 Russian.  
[293-12497]

UDC 621.396.019.4

SYNTHESIS OF OPTIMUM RECEIVER AND PROCESSOR FOR INTERFERING RADIO PULSE SIGNALS

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received 4 Sep 83)  
pp 28-30

RYABTSOV, A. L.

[Abstract] Synthesis of the optimum receiver-processor for interfering radio pulse signals is considered, assuming an additive mixture of useful signal and interference signal at the input. The useful signal is one resulting

from interference of an incoming pulse and the reflected pulse which lags behind the former by a random time interval. The problem is formulated as one of estimating the state vector, which satisfies the corresponding a priori stochastic differential matrix equation, and solving the appropriate general equations of optimal nonlinear filtration in accordance with the theory of conditional Markov processes. A quasi-coherent receiver constructed on this basis contains a shaper of unit-amplitude video pulses, two tunable oscillators and two delay-time estimator channels, and an array of amplifiers controlled by a gain computer which takes into account the phase relation between interfering signals. Figures 2; references: 4 Russian.  
[301-2415]

UDC 656.259.12(083.73)

#### UNIFIED NOTATION AND TERMINOLOGY FOR RAILROAD CIRCUITS

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 pp 6-8

YEZHOVA, L. A., engineer

[Abstract] Involvement of a large staff in planning and design as well as installation and maintenance of railroad signalization and automatic remote control, including trainees alongside engineers and operators, presents an urgent need for unified notation and terminology pertaining to railroad circuits. This in turn requires a classification which will cover the existing three modes of propulsion, the various communication system frequencies, the recently completed incorporation of automatic locomotive signalization, continuously improved circuit components, and increasingly centralized electric power supplies. Definitions issued by the USSR, CEMA and International Railroad Unions over the 1963-79 period, and by the USSR Academy of Sciences in 1952 should serve as a basis for such a standardization. These definitions must be adjusted and reconciled, if necessary, in order to avoid any ambiguities and distortions. The first most significant indicator of a railroad circuit is compatibility between track signalization and locomotive signalization equipment. The second most significant indicators are more numerous and diverse. It appears most expedient to use a two-part notation, the first part identifying the type of circuit by code letters or acronyms and the line frequency explicitly. Letters and numerals in the second part should represent circuit characteristics of second-order significance. Such a system of notation with the underlying terminology should apply to track circuits, station circuits, and mountain circuits. Tables 2.  
[306-2415]

## CENTRALIZED QUALITY CONTROL OF TRAIN RADIO COMMUNICATION

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 p 22

RESHETNEV, F. F., senior engineer, signalization and communication service, Odessa railroad line; and LOGVINENKO, L. D., senior engineer, train laboratory of railroad automation, telemechanics, and communication

[Abstract] Train radio communication equipment is inspected periodically at stations and junctions as well as from a coach-laboratory. Inspection of this equipment on the Odessa railroad line has been centralized, its performance at any point along the line being now checked directly in the main control building. Equipment for such a quality control includes a PU-4D panel to which communication routing devices are connected through a tone-frequency channel with cords and switches according to the four-wire scheme. The instrumentation, developed and proposed by D. A. Novikov, senior electromechanic, consists of a VZ-38 millivoltmeter connected to the antenna of the locomotive radio station through the ZhR-K-LP receiver preselector switch. Test signals at 1000 Hz frequency are transmitted and received for measurement of signal level according to official procedure. The train communication equipment is checked against station communication equipment with 1000 Hz and 1400 Hz signals. Data are processed directly and faults, if they are found to exist, can be cleared immediately. Figures 2.

[306-2415]

UDC 656.254.16:621.396.6.004

## TUNEUP AND REPAIR OF RN-12B RADIO STATION

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 pp 26-30

LAPSHIN, B. M., senior engineer, and BREZGUNOV, V. T., senior engineer, Signalization and Communication Center, USSR Ministry of Railroads

[Abstract] The portable radio station RN-25B has been designed for simplex two-way radio telephone communication, without scanning and fine tuning, in the 148-174 MHz frequency band over up to five high-frequency channels 25 kHz apart. It consists of a transmitter-receiver module, a manipulator set, and a power pack. All active components are built with transistors and integrated microcircuits. A procedure and test circuitry with instrumentation have been devised for tuneup and repair, if necessary, of all components in proper sequence. The transmitter operates with phase modulation and quartz-crystal frequency stabilization. The receiver operates with two intermediate frequencies. The testing and tuning sequence in the receiver is: first heterodyne, second heterodyne, second mixer, second-i-f amplifier, detector, l-f amplifier, h-f amplifier, first mixer, first-i-f amplifier, noise suppressor. The sequence in the transmitter is: exciter, frequency multiplier and preamplifier, power amplifier, protective circuit. The transmitter is also d.c. tested and tuned, and the modulator is tested and tuned separately with an audio oscillator. The testing and tuning of PM801 and PM802 manipulators is: commutator

circuits, ringing transmitter, ringing receiver. The power pack with batteries is checked and regulated against a stabilized power supply, with the radio station operating as transmitter, at least 10 V being needed for an audible signal to appear in the manipulator loudspeaker. Figures 4; tables 2.  
[306-2415]

UDC 658.382.3:656.25:62-78

#### INSPECTION OF PROTECTIVE EQUIPMENT ALONG TRACK SIGNALIZATION AND COMMUNICATION LINES

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 pp 33-34

TEPLOV, N. A., engineer, laboratory of automation, telemechanics, and communication, Odessa railroad line

[Abstract] Centralized inspection of protective and safety equipment along 110-380 V track signalization and communication lines has been tried and found to be more efficient than decentralized inspection of this equipment. The procedure includes testing dielectric rubber mats, shoes, gloves, tool handles, belts, claws, ropes, ladders used by linemen for work under voltages up to 1000 V, testing lightning arresters and discharge gaps, checking and repairing automatic power circuit breakers, checking voltage rises across capacitor banks, and checking insulation on wire-communication system components--in accordance with instructions and specifications issued by the USSR Ministry of Railroads. For centralized implementation of this procedure, inspection points along the lines are equipped with a UPU-1M universal 10 kV d.c./a.c. megger, an IR-3M portable 50-3500 V d.c. spark gap tester, fuse testers, and necessary meters. The procedure, including also an adequate system of data logging and evaluation for corrective and preventive action, has been adopted on several railroad lines such as the Nikolayev line.

[306-2415]

#### USING POWER PACK OF 38RTS-A2-ChM RADIO STATION FOR CHECKING LOCOMOTIVE RADIO STATIONS

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 pp 35-36

RYUMIN, R. A., chief, Riga track section and Control of Baltic Shore railroad line

[Abstract] The voltage necessary for preventive inspection of 39RTM-A2-ChM and 72RTM-A2-ChM locomotive FM radio stations is now drawn from power packs connected to the power line through a VSA-5 rectifier with smoothing filter. This arrangement is neither efficient nor convenient, because of an up to 140 W power loss in the rectifier and instability of the rectifier output voltage during switching. With the assistance of P. N. Afanas'yev, student-trainee from the Kiev Electromechanical Engineering College, the power pack

of a 38RTS-A2-ChM RM radio station has been adapted for this inspection. On the 12 V side of the power transformer has been added a coil of 97 turns using PEV2-0.1 vinyl-coated enamelled copper wire and on this transformer has been mounted a rectifier bridge with smoothing filter, also an RES22 relay which switches the tested radio station from "receiver" mode to "transmitter" mode. This arrangement makes the inspection more reliable. Figures 1.  
[306-2415]

#### LONGER LIFE OF LAMPS ON RADIO RELAY TOWER

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 p 36

LEMPER, Ye. A., senior engineer, Gorkiy-Moscow track section of Gorkiy railroad line

[Abstract] Lamps for illuminating a radio relay tower often burn out early as a result of voltage fluctuations. Two senior engineers, A. F. Shtompel' and A. Ya. Antonov, have modified the voltage supply circuit so as to soften this effect on the lamps. The "flashing" circuit consists of an asymmetric multi-vibrator with two MP26 transistors which control a KU202N transistor inserted into the supply line, a D246 diode which holds the supply voltage during the reverse half-cycle, a D808 stabilatron, and two D226 diodes. The multi-vibrator frequency is close to 1 Hz and can be regulated over the 0.3-1.0 Hz range for varying the glow from half to full intensity by varying the flash rate from 20 to 60 per minute. This arrangement reduces the consumption of electric energy by approximately 40%, in addition to reducing substantially the frequency of lamp replacements and the attendant maintenance labor cost. Figures 2.  
[306-2415]

#### FAULT LOCATOR FOR RAILROAD CIRCUITS

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 pp 38-39

CHUBAROV, L. B., candidate of physico-mathematical sciences, docent, and ZOMERFRAYND, G. M., junior scientific associate, Tashkent Institute of Railroad Transportation Engineers, KRAVTSOV, B. I., chief, signalization and communication services, Central Asiatic railroad line

[Abstract] Approximately 30% of all faults in railroad signalization, centralization, and interlocking circuits using rails as current paths are caused by breaks along a rail or shorts through a crosstie. A locator of such faults in both d.c. and a.c. circuits has been developed, to replace the insufficiently sensitive IRTs-58 inductive device and to avoid using many voltammeters instead. This instrument consists of an input device, and amplifier with negative feedback, a detector, an amplifier-expander, a buzzer and an indicating lamp, and a power supply. The input device is a magnetic

field probe with an inductance of 3500  $\mu$ H consisting of a coil with 300 turns of enameled copper wire wound on a rod core of F600 ferrite material 8-mm in diameter and 160-mm long. The amplifier is built with K237UN3 integrated microcircuits. On the output side it is coupled through two capacitors to a high-impedance telephone receiver and a detector built on D9Zh germanium diodes rather than silicon diodes, in order to ensure higher sensitivity. The amplifier-expander behind the detector is built on a KT315B transistor with an AL307 light-emitting diode and a current-limiting resistor in the collector circuit. The power supply consists of four TsNK-0.45-11-U2 batteries and a D226 rectifier diode with a ballast resistor for boost charging to approximately 5 V. The locator was tested and found to be very reliable; it gave no false readings. Figures 1.

[306-2415]

UDC 621.365.2.001.8

EXPERIENCE AFTER INTRODUCTION OF NEW ENGINEERING METHODS AND MANUFACTURING PROCESSES IN NOVOSIBIRSK ELECTROTHERMAL EQUIPMENT MANUFACTURING PLANT

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 24 Oct 83) pp 32-35

ORLOV, G. I., candidate of economic sciences, and ZAV'YALOV, V. G., engineer, "Sibelektroterm" Production Association

[Abstract] New equipment produced during the 1975-82 period at the Novosibirsk electrothermal equipment manufacturing plant, the leading enterprise of the "Sib. lektroterm" Production Association, includes DSP-100I6 superpower electric steel making furnaces, smaller 12-50 ton DSP furnaces, RKO-22.5/SMN-11 (22.5 MVA) electric furnaces for replacement of the existing 16.5 MVA ones at the Zestafan ferrous alloys production plant, and ESP-30/2500-11 (30 ton) as well as ESP-100/7500-11 (100 ton) electron-beam steel casting furnaces. Since 1982 are also available large SDO-45.220.4/10-200-11 and SDO-45-120.45/10-140-11 electric furnaces. The major innovation introduced for manufacture of these furnaces are: machine tools with digital program control, with top-quality cutters, with universally adaptable accessories and jigs, and with use of natural or synthetic diamonds for tool sharpening and for cutting nonmetallic materials; also ion-plasma nitriding and surface coating, electrolytic galvanizing and chrome plating, punch presses designed for minimum or zero waste of blank material, and more productive assembly lines. Figures 2. [300-2415]

SYSTEM OF MICROPROCESSOR INSTRUCTIONS

Moscow AVTOMATIKA, TELEMekhANIKA I SVYAZ' in Russian No 5, May 84 pp 18-21

LOKHMATYY, V. Ye., candidate of technical sciences, docent, Leningrad Institute of Railroad Transportation Engineers, imeni Academician V. N. Obraztsov; and TRAN'KOV, S. N., engineer

[Abstract] The system of instructions for the KR580IK80A microprocessor includes instructions to perform arithmetic operations, instructions to perform logic operations, instructions to perform control transfer unconditionally or conditionally, instructions to control the stack, the input, the output, or the state of the microprocessor, and instructions to allow or forbid interrupt. Arithmetic operations are addition and addition with carry, subtraction and subtraction with borrow, incrementing a register, a register pair, or a memory cell, addition of contents in HL register pair to contents in any pair of registers, and decimal correction of an adder. Logic operations are conjunction of accumulator contents with register contents ANA R, conjunction of accumulator contents with a constant ANI DATA, exclusive OR (A) with (R), comparison of accumulator contents (A) with register contents (R), cyclic shift to left RLC of accumulator contents (A), and cyclic shift to left through carry tag RAL of accumulator contents (A). For illustration, two simple programming tasks are performed with such instructions. Task 1: add last four digits in a memory cell with address 10H to first four digits in the next memory cell and store the sum in the latter; the reader is asked to perform the same task using instructions with direct addressing. Task 2: transfer to zero a group of memory cells in 10H array beginning with address 15H; the reader is asked to perform the same task for a group of memory cells beginning with address 15H and ending with the cell which contains code FFH. Figures 2; tables 2; references: 2 Russian; 2 Western (in Russian translation). [306-2415]

## CONTROL SYSTEMS

UDC 656.342:658.012.011.56:629.048

### AUTOMATIC CONTROL SYSTEM FOR SUBWAY CURTAINS

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 pp 10-11

LAVRENT'YEV, G. F., chief, electrical track protection and automation, electro-mechanical service, Moscow subway system

[Abstract] Curtains are installed in subways in order to prevent cold outside air from leaking in and heat inside from leaking out through open gates and gaps in closed gates. An automatic control system for such curtains servicing as a means of temperature regulation on subway platforms has been developed and is ready for commercial production. It is based on the principle of an electronic proportional regulator (PTP-P) with a servo valve (25Ch 931 NZh). The system is designed for three modes of operation: 1) remote control from dispatcher room; 2) remote control from automation panel; 3) local blower control. In order to enable the dispatcher equipment to cope with an extra load imposed by frequent switching, it was necessary to develop also a special automatic programmer. The latter consists of an RS-trigger, two shift registers, a pulse generator, a pulse shaper, two arrays of AND logic, a delay line, and a command selector switch--all built with integrated microcircuits. Signals can be sent to any number of dispatchers through a special relay attachment. The pilot programmed control system operates already in eight stations of the Moscow subway system. It has improved the control of curtains, reduced the maintenance time, and also reduced the heating cost. Figures 2.  
[306-2415]

UDC 621.315.61:537.226.32:539.166

BUILDUP OF ELECTRIC CHARGE IN FOIL DIELECTRICS DURING GAMMA IRRADIATION

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 9 Oct 83)  
pp 51-54

MAKEYEV, S. N., candidate of technical sciences, FILATOV, N. I., engineer,  
and SHMIGOL', A. T., engineer

[Abstract] Theoretical and experimental studies of electric volume charge building up in polymer foils under ionizing radiation reveal two mechanisms at work here. One is the difference between the absorption capacities of the foil material and of the other material in contact with it, the second mechanism is knockout and slowdown of Compton electrons. Seven industrial grades of polymer materials in foils of 0.2-2.0 mm thickness were exposed to gamma radiation in doses of 1.3-6 kg-r from a  $^{60}\text{Co}$  source at 100°C: SF-2-50 and SF-2N-50 (glass-Textolite), FDM-2 (glass-Textolite), GF-2-50, PEVD (high-density polyethylene), PKT-5, FLAN-10. Data were obtained on the buildup of volume charge density as function of the irradiation dose and as function of the intensity of the external electric field (one electrode grounded, one electrode connected to electrometer amplifier) at two fixed irradiation doses, also on the volume-charge relaxation as function of time ( $\rho = Bt^{-\alpha}$ ). The data were evaluated in terms of thermal-stimulation current, the charge calculated by graphical integration of thermostimulated current curve. The results indicate that both processes do depend in a complex manner on the kind and the thickness of the dielectric foil material as well as on the conditions of irradiation and storage respectively. Figures 5; tables 2; references: 5 Russian.  
[300-2415]

## PARTIAL DISCHARGES IN AND ELECTRIC STRENGTH OF HIGH-VOLTAGE POLYMER INSULATION AT CRYOGENIC TEMPERATURES

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 6 Jun 83)  
pp 58-62

VDOVIKO, V. P., candidate of technical sciences, SHUMILOVA, E. D., candidate of technical sciences, MIKHAYLOV, V. V., candidate of technical sciences, ANDRYUKHIN, S. P., candidate of technical sciences, SHATOKHIN, V. M., engineer, and AKSENOVA, Ye. I., engineer, Siberian Scientific Research Institute of Power Engineering

[Abstract] A study of partial discharges in multilayer polymer insulation in liquid nitrogen was made, for the purpose of determining the effect of over-voltages on initiation of such discharges and the laws of material breakdown at cryogenic temperatures. Specimens of six high-voltage insulation materials (polytetrafluoroethylene, polyethylene tetrathalate, high-density polyethylene, polyimide, polypropylene and polypropylene paper) in stacks of 2-12 layers of corresponding 45-520  $\mu\text{m}$  total thickness were first tested under alternating voltages with the frequency varied from 50 to 1000 Hz. They were also tested under a 300 Hz oscillatory voltage pulse simulating a switch-on surge, with a logarithmic decrement of 3, superposed on a 50 Hz alternating voltage in phase with the positive amplitude of the latter. The data, evaluated in terms of insulation life  $\tau$  as function of the electric field intensity  $E$  ( $\tau = A_1 E^{-m}$ ) and as function of the frequency  $f$  ( $\tau = A_2 f^{-K}$ ), serve as basis for accelerated testing within given voltage and frequency constraints which take into account the aging factor. A statistical analysis based on the Weibull distribution and linear regression yields the values of constant coefficients and exponents in those relations. Typical calculations and resulting values based on a 0.05 significance level are shown for polytetrafluoroethylene with an intentionally built-in "defect". In a separate study partial discharges were tracked in an epoxy compound containing hermetic inclusions, in a 50 Hz alternating voltage with the amplitude smoothly raised at a rate of 150 V/s to 1.6 times the discharge initiation level and then reduced to zero. Such voltage cycling was interspersed with temperature cycling from cryogenic to room temperature and back. Figures 8; tables 1; references 12: 6 Russian, 6 Western.

[300-2415]

## ELECTROMAGNETIC COMPATIBILITY

### ELECTROMAGNETIC COMPATIBILITY OF RADIOELECTRONIC EQUIPMENT FOR RAILROAD TRANSPORTATION

Moscow AVTOMATIKA, TELEMekhANIKA I SVYAZ' in Russian No 5, May 84 pp 42-46

VAVANOV, Yu. V., candidate of technical sciences, chief, radio communications laboratory, All-Union Scientific Research Institute of Railroad Transportation

[Abstract] The terminology pertaining to electromagnetic compatibility of radioelectronic equipment, formalized in GOVERNMENT STANDARD 23611-79, is also applicable to radioelectronic equipment for railroad transportation. It includes definitions of unintentional radio interference, acceptable radio interference, intersystem radio interference, intrasystem radio interference, radio transmitter, radio receiver, radio reception, antenna, principal radio emission, necessary radio frequency band, extraband stray radio emission, harmonic radio emission, sideband radio emission, subharmonic radio emission, combination-frequency radio emission, intermodulation radio emission, intraband parasitic radio emission, principal radio reception channel, sideband radio reception channel, suppression in radio receiver, crosstalk distortion in radio receiver, susceptibility of radio receiver, acoustic interference, low-frequency interference, propagation medium, multiplicative interference, industrial interference from rolling stock and electric power transmission lines, interfering radio stations, range of radio station, coordination distance, receiver noise, high-frequency noise along supply and control lines, low-frequency interference in reception channel, and acoustic interference. The classification of interference and noise is accompanied by a description of each kind and by a recommendation of countermeasures. Figures 5; tables 2. [06-2415]

METHODS OF RELIABILITY DESIGN OF SEMICONDUCTOR POWER DEVICES

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 4 Jul 83)  
pp 42-49

GRIGOR'YEV, A. M., candidate of physico-mathematical sciences and SHPER, V. L., engineer, All-Union Order of Lenin Electrical Engineering Institute imeni V. I. Lenin

[Abstract] Reliability design of semiconductor power devices requires a classification of operating modes, calculation of the reliability indicators for each class, and convertibility from set of operating modes to another, either in the same class or in another one. There are noncyclic and cyclic modes of operation, the probability of failure-free operation or the failure rate in noncyclic modes depending foremost on the mean temperature of the device and the applied voltage. Cyclic operation is characterized by temperature cycles, pulse cycles, current overloads, or combinations thereof. Appropriate relations for the reliability indicators as functions of the corresponding variables are established for each type of operating mode, failure rate  $\lambda_t = \lambda(T, V) K_s K_q K_o$  ( $T$ - temperature,  $V$ - voltage, coefficients  $K_s$ ,  $K_q$ ,  $K_o$  characterize, respectively, the stiffness of an operating mode, the quality of a semiconductor device, and ambient conditions) for noncyclic operation and number of cycles till failure  $N = \phi_c (\Delta T)^{-m}$  ( $\Delta T$ - amplitude of temperature fluctuations,  $\phi_c$  - constant coefficient,  $m$ - constant exponent). These relations are explicated for each specific class of operating modes or their specific combinations, nomograms and histograms being used as aids for calculating the reliability indicators. In the case of varying modes the failure distribution must be taken into account, considering that the time scale rather than the distribution law may change. The most commonly applicable distributions are Gauss (normal), log normal, exponential, exponential-decreasing, extremal of first kind, and Weibull. This approach to reliability design of semiconductor power devices is illustrated with four typical examples, and it is confirmed by an analytical procedure for defining classes of operating modes. Figures 4; tables 4; references 10: 8 Russian, 2 Western.  
[300-2415]

## NEW POWER TRANSISTORS

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 pp 46-47

GROSHEVA, G. D.

[Abstract] The following new power transistors are now produced commercially for high-frequency operation: KT950A (70 W - 80 MHz), KT950B (50 W - 30 MHz), KT951A (25 W - 80 MHz), KT951B (20 W - 30 MHz), KT951V (3 W - 80 MHz), KT964A (150 W - 80 MHz), KT980A (250 W - 30 MHz) and for high-voltage switching KT840A ( $V_{CE,max} = 900_X/400_R$  V), GT840B ( $V_{CE,max} = 750_X/350_R$  V) (X - maximum pulse voltage with reverse emitter-base bias, R - maximum d.c. voltage with given emitter-base resistance). The housing construction is KT-18 for KT950 transistors, KT-17 for KT951 transistors, and KT-19 for KT964, KT980, KT840 transistors. Tables 2.  
[306-2415]

UDC 535.317

## INFLUENCE OF EDGE EFFECTS ON PERFORMANCE OF ELECTROOPTICAL LENS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 5 Jul 82) pp 1405-1407

GUSAK, N. A. and MASHCHENKO, A. G.

[Abstract] The influence of edge effects on electrooptical lens performance is quantitatively assessed by solving the problem of the potential distribution in a crystal with semiinfinite electrodes. Significant distortions are detected along the x axis, which are plotted as a function of the distance from the center of the lens, demonstrating good agreement between the theoretical and experimental data. The nature and amount of distortions are found as a function of the degree of limiting of the electrodes. Figures 3; references: 3 Russian.  
[318-6900]

UDC 537.533.3

## DESIGN OF ELECTROOPTICAL SYSTEM WITH ANNULAR CATHODE AND ELECTROSTATIC COMPRESSOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 14 Jan 83) pp 1429-1430

YEROSHCHENKOV, Ye. K., YESICHEV, A. B., ZAV'YALOV, M. A., KAZAKOV, A. I. and KUDRYASHOV, Yu. V.

[Abstract] An electrooptical system employing an annular converging beam and an electrostatic compressor is examined in which the beam is compressed in

the compressor field and gradually takes on a solid cylindrical form. The compressor is a system of two electrodes consisting of coaxial conical surfaces. The electrons are deflected and put into trajectories parallel to the axis by the transverse electrical field of a compressor, which is also the anode of the electrooptical system. Optimization by numerical analysis is performed by computer with allowance made for a relativistic increase in the mass and intrinsic magnetic fields of the beam. The optimum radius of curvature of the emitter surface is found to be significantly larger than that indicated in the preliminary calculations, and can be increased to infinity with no significant loss of laminarity of the trajectories.

Figures 1; references: 6 Russian.

[318-6900]

UDC [66.013.6:658.26].004.18

ENERGY SAVING TECHNOLOGY IN CHEMICAL INDUSTRY

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 5, May 84 pp 2-4

CHURAKOV, S. D., engineer, Ministry of Chemical Industry

[Abstract] The major energy saving strategies in the chemical industry are improving the technological processes, developing fundamentally new technologies, adopting appropriate production methods, developing large-scale production lines, and using nonconventional fuels such as low-grade coal and nuclear fuel. These strategies are being implemented in fiber, dye, and other manufacture as well as in water treatment, with greater utilization of secondary energy sources and application of automatic control. Typical examples are manufacture of calcinated soda and caustic soda, caprolactam, polyethylene and vinyl chloride, methanol, and chloromethanes. Among the new achievements in energy saving are development of highly efficient catalysts, introduction of plasmochemical (cold plasma) and photochemical methods of manufacture, and replacement of such processes as rectification, extraction, vaporization, desiccation with reverse osmosis, electrodialysis, of ultrafiltration. The fuel economy and the cost effectiveness have improved in many plants, among them Sterlitamak and Berezniki "Soda" works, Sterlitamak "Kaustik" works, Tomsk Chemical works, Prikumsk "Plastmass" works, Novopolotsk "Polimir" works.

[299-2415]

## WAYS TO REDUCE CONSUMPTION OF ELECTRIC ENERGY FOR PROCESSING IN ELECTROLYTIC REFINEMENT OF COPPER

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 5, May 84 pp 14-15

PUZAKOV, V. V., candidate of chemical sciences, and ZAUZOLKOV, I. V., candidate of chemical sciences, Ural Scientific Research and Planning Institute of the Copper Industry; ZAGORODNIKOV, M. P., engineer, "Urakelektromed" Combine; MELOYAN, R. G., candidate of technical sciences, Armenian Pedagogical Institute imeni Kh. Abovyan

[Abstract] The electric energy necessary for copper refinement in an electrolytic trough is calculated on the basis of Faraday's law and Kirchhoff's law, the latter taking into account cathodic and anodic polarization as well as voltage drops across the electrolyte and the contacts. These relations indicate where and how electric energy for refining can be saved by equipment and process design. An evaluation of statistical production data from the "Urakelektromed" Combine by the method of a planned mathematical experiment has yielded the regression equation  $w \text{ (kW.h/ton)} = 727.3 + 1.87i_c - 1.84C_{\text{CuSO}_4 \cdot 5\text{H}_2\text{O}} - 3.53C_{\text{H}_2\text{SO}_4}$  ( $i_c$  A/m - cathode current density, C- concentrations of salt and acid).<sup>2</sup> Calculations for minimizing the voltage drops across, the cathode rod contact and the anode lug (Whitehead contact) are facilitated by an  $i_c$ -C-w nomogram. Figures 1; references 4: 2 Russian, 1 Polish, 1 Western. [299-2415]

## AUTOMATIC SYSTEM FOR CONTROL OF ELECTRIC ENERGY CONSUMPTION IN LARGE INDUSTRIAL ENTERPRISES

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 5, May 84 pp 33-35

LEPORSKIY, V. D., candidate of technical sciences, ZAMIDRA, V. I., engineer, and FILATOV, A. G., engineer, Kiev Polytechnic Institute imeni 50-th Anniversary of the Great Socialist October Revolution

[Abstract] An automatic system for controlling the electric energy supply was installed in the "Uralasbest" Combine in 1982. The combine contains an electric energy supply system which branches out intricately and consists of interconnected transformer substations, distribution stations, underground and overhead transmission lines, and various energy users, on the average approximately 14% of all energy being consumed for asbestos production. The first-generation automatic control system performs five functions: 1) Gathering and preprocessing of operational data; 2) Commercial and technical accounting of active and reactive power flowing in the combine, its component plants, and its subsidiaries; 3) Monitoring of departures from limits during assigned periods of time;

4) Inspection for half-hourly active and reactive power peaks; and 5) Predicting the levels of active and reactive power in subsequent periods. The hardware includes an M-6000 computer, TM-301 telemechanics with 15 monitors, and interface between both, and a communication link between them, as well as more than 600 SAZU-I670D kilowatt-hour meters and SR4U-I673D kilovar-hour meters. The software is written in the machine-oriented MNEMOKOD language, as a part of the real-time disk operating system. The next step will be to change over to an automatic system for control of the electric energy consumption. Figures 2; references: 31 Russian. [299-2415]

UDC 621.513.004.68

#### INCREASING EFFICIENCY OF RECIPROCATING COMPRESSORS BY MEANS OF ACOUSTIC SUPERCHARGE

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 5, May 84 pp 43-45

RUTKOVSKIY, Yu. A., candidate of technical sciences, Kommunar'sk Institute of Mining and Metallurgy

[Abstract] A study of VP-20/8M and VP-50/8M reciprocating air compressors has revealed large amplitudes of pressure fluctuations in the suction pipe during resonance at the fundamental frequency of forced vibrations. These fluctuations, which reach amplitudes of  $0.17-0.23 \text{ kgf/cm}^2$ , increase the air feed rate by 8.5-15.4% relative to free run. Acoustic supercharge utilizing these fluctuations would increase the production of compressed air without additional equipment or special redesign, but there is still a wide discrepancy between experimental and theoretical data as well as a lack of data on the dependence of the efficiency of acoustic supercharge on the pipe diameter, on the effect of drag, and on the economics of acoustic supercharge. In this paper the performance characteristics of a 5G-100/8 air compressor consisting of a double-action cylinder and a suction pipe are analyzed from the standpoint of resonance in two limiting configurations: 1) Pipe open at one end and closed at the other end so as to make the volume of the cylinder cavity effectively negligible; and 2) Pipe open at one end and feeding into a cylinder at the other end. This analysis yields results much closer to experimental data and suitable for design of the cylinder-pipe system. Calculation of economic indicators show that the cost of compressing air with such a compressor can be reduced by 0.06 rubles/1000  $\text{m}^3$  while the production of compressed air will increase by 20,000  $\text{m}^3$  annually. Figures 2; tables 1; references: 3 Russian. [299-2415]

## RELIABILITY OF ELECTRICAL EQUIPMENT IN PETROLEUM AND NATURAL GAS INDUSTRY

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 5, May 84 pp 60-61

POKONOV, N. Z.

[Abstract] In December 1983 a scientific and technical conference was held in Moscow by the Power Engineering Section at the Central Administration of the Scientific-Engineering Association imeni I. M. Gubkin for the Petroleum and Natural Gas Industry. The conference dealt with reliability of electrical equipment in oil and gas production enterprises, specifically synchronous motors for driving pumps and drills, lights and heaters, power distribution lines, switches and contactors. Sixty-four experts who represented the various pertinent Ministries as well as the Ministry of Higher Educational Institutions participated in the conference. After a review of existing conditions and the state of the art, recommendations were made as to further action. The Ministry of the Electrical Industry was requested: 1) To accelerate the development of necessary equipment models and sizes; 2) Improve the quality of repair work on synchronous motors, induction motors, and transformers; 3) To develop drilling equipment such as 6-10 kV distribution lines, 10 kV motors, d.c. motors with thyristorized converters, rugged and economical incandescent and mercury-arc lamps, and cables with oil-resistant and benzene-resistant insulation; 4) To standardize plugs and sockets for hose cables; 5) To instruct the Lys'va Turbogenerator Manufacturing Plant to resolve the problem of overvoltage suppression in circuit breakers for synchronous motors, 6) To see that mounting plates for modernizing the installation of exciters be delivered, that the rotors of STD-12500 synchronous motors be redesigned, that synchronous motors with lateral-intake air cooling and built-in current transformers be produced, and that repair facilities for motor coils with "Monolit-2" insulation be set up; 7) Instruct the "Soyuz-elektrosvet" plants to improve the quality of lighting equipment, especially DRIZ-700 lamps and starter-dimmer devices; 8) To develop and produce 6/0.4-3 kV 320-630 kVA transformer substations for submersible centrifugal pumps and portable electrical equipment for underground maintenance work in oil wells, 6-10 kV 3-8 MW synchronous motors with brushless exciters for installation in sheds, and programmable automatic excitation regulators for large synchronous motors; and 9) Instruct the Rovno High-Voltage Equipment Manufacturing Plant and the Ul'yanov "Kontaktor" Plant that the interphase insulation in VD-10 (3200 A) circuit breakers be strengthened and the AVM-20 automatic switches be debugged. The Ministry of Construction for Oil and Gas Producing Enterprises was requested to construct 6-10 kV overhead transmission lines in accordance with the latest Construction Norms and Regulations, improve the quality of electrical installation work without deviations from blueprints, broaden the implementation of methods and solutions developed by scientific research and design organizations. The Ministry of the Petroleum Industry was requested to solve the problem of electric energy measuring Instruments and their integration into the automatic process control system, as well as to organize the 1984 seminar on KTPPN and KTPSK distribution apparatus, ShGS-5803 control stations, and BUS-3M control modules.

[229-2415]

## DESIGN OF INDUCTIVE SHIFT TRANSDUCERS

Moscow ELEKTRICHESTVO in Russian No 5, May 84 (manuscript received 26 Jan 83)  
pp 70-71

GUSEL'NIKOV, V. K.

[Abstract] Today plunger-type inductive transducers detecting shifts are simple in design, show good metrological indicators, and consist essentially of an induction coil and a ferromagnetic core. The design problem is to increase sensitivity and to reduce error. However, the determination of operating characteristics on the basis of electromagnetic circuit theory is difficult and leads to many errors. Consequently, an experimental set-up was made which consisted of a measurement generator containing the transducer coil, a micrometer screw and a frequency meter. It was used to establish relations for operational parameters which make it possible to design a transducer of the required size with the necessary sensitivities and error limits and to specify the required design parameters. Figures 2; tables 1; references: 4 Russian.  
[293-12497]

UDC 621.384.3

QUANTIZER OF IMAGES OF HEAT FIELDS OBTAINED BY RUBIN-TYPE INFRA-RED IMAGERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 84  
(manuscript received 18 Apr 83) pp 23-25

SHABASHEV, O. K., MURAVEYSKAYA, A. A. and BEREZIN, S. V.

[Abstract] A device for quantizing images of heat fields for RUBIN infrared images is described which produces an image with discretely-varying density, in addition to the half-tone black and white heat field image. Quantized images are contained with the help of RUBIN infrared images by exploiting the fact that the characteristics code of the EKHB-4 electrochemical paper employed allows 10 visually-discriminable densities to be recorded using the corresponding gamma-correction. The quantizer provides three operating modes which differ in quantization step and number of isotherms recorded on the thermogram. The quantizer permits fast, accurate visual analysis of heat field images. Figures 4; tables 1; references: 2 Russian.  
[283-6900]

MAGNETIC SHIELDING WITH SUPERCONDUCTORS BASED ON NIOBIUM-TIN COMPOUNDS

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 6 Jun 83)  
pp 49-51

KALASHNIKOV, R. V., engineer, TRUSOV, N. B., engineer and ZVENIGORODSKAYA, A. N., engineer, All-Union Order of the Red Banner of Labor Scientific Research Institute of Electromechanics

[Abstract] Use of superconductors for shielding magnetic fields offers several advantages, they can be made smaller in size and mass than shields made of ferromagnetic metals (iron, steel) because of their higher saturation induction in constant magnetic fields and thinner than shields made of nonmagnetic high-conductivity metals (copper, aluminum) because of the stronger skin effect in low-frequency alternating magnetic fields. The behavior of a type-2 super-conductor materials such as  $Nb_3Sn$  in an external magnetic field is analyzed on the basis of the Kim-Hempstead-Strand model and the appropriate Maxwell equation for penetration depth in a plate. An experimental study was made with a search coil inside a UIS superconducting solenoid, this search coil consisting of 600 turns of enamelled and triple nylon-covered 2NT (niobium-tin) wire 0.5 mm in diameter. Two kinds of cylindrical shields with an inside diameter of 28 mm were used: 1) monolithic ones made of Nb and Sn powders sintered at 1050°C and formed into shells of 2-8 mm wall thickness; 2) laminate ones made of 0.1 mm thick  $Nb_3Sn$  tape wound into shells of 1-40 layers and correspondingly with 1-4 mm wall thickness. Measurements at 4.2-73 K temperatures were made in a constant magnetic field of 1 T and in an alternating magnetic field with the amplitude varied from 0.3 T at 5 Hz to 0.2 T at 50 Hz as well as in both fields superposed. The results indicate that both forms of  $Nb_3Sn$  superconductor material can effectively shield constant and alternating magnetic fields as well as weak alternating fields superposed on strong constant ones, letting the latter pass through. According to the data, laminate shields are more effective than monolithic ones. Figures 5; references 4: 2 Russian, 2 Western (1 in Russian translation). [300-2415]

ANALYSIS OF SOLUTION OF BLOCH'S EQUATIONS IN TIME DOMAIN

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 16 Apr 82) pp 1417-1420

LEVIN, Yu. K.

[Abstract] The significance of the third term of the spectral solution of the Bloch equation for three-pulse operation of a spin device is analyzed by examining the time-domain solution of the Bloch equation characterizing the behavior of the magnetization vector of a spin packet precessing about a constant internal magnetic field directed along the z axis with a radio-frequency magnetic field applied along the x axis. It is shown sufficient to use the first two terms of a spectral solution of the Bloch equations to describe the spin device; the justification for discarding the third term of the solution is validated. The author thanks V. P. Belavkin and N. V. Titarenko for helpful advice. References 6: 4 Russian, 2 Western.  
[318-6900]

RECORDING SMALL FREQUENCY DRIFTS OF MICROWAVE OSCILLATORS

Moscow RADIOTEKHNIKA in Russian No 5, May 84 (manuscript received 23 May 83)  
pp 90-92

DENISOV, V. P., LEBEDINSKIY, S. A. and NAZAROV, V. I.

[Abstract] A method of recording small frequency drifts of ultrahigh-stability microwave oscillators by heterodyning without causing instability is proposed, a method which involves two frequency stepdowns with subsequent measurement of period fluctuations in the low-frequency signal by means of an electronic period counter. The latter contains an internal quartz oscillator and its relative error of period measurement, which determines the sensitivity of the method, depends on the period of its fluctuations and on the signal-to-noise ratio at its output as well as on the relative frequency instability of that quartz oscillator. When the signal-to-noise ratio is high, above 60 dB, then the fluctuation period of that quartz oscillator becomes the dominant factor and the sensitivity of the method is proportional to the low frequency squared. The instrumentation includes a balanced microwave mixer (output frequency 200 kHz with 75 dB decoupling between main and heterodyning oscillators) in the form of a hybrid ring of microstrip lines with a ferrite diode at each of the two inputs and an amplifier on the output side in the first stage, a low-frequency mixer (output frequency 1000 Hz) feeding through a tuned amplifier into the electronic period counter with a frequency synthesizer acting as heterodyne (relative frequency instability  $10^{-10}$  over a 10 s period) in the second stage, and a monitoring spectrum analyzer across the counter input. Figures 1; references 3: 2 Russian, 1 Western.  
[301-2415]

MICROCIRCUIT HETERODYNE RESONANCE INDICATOR

Moscow RADIO in Russian No 5, May 84 pp 50-52

VASIL'YEV, V., Kuybyshev

[Abstract] A heterodyne resonance indicator for all six amateur bands, from 10 to 160 meters, is proposed for aligning amateur radio equipment. The device consists of two microcircuits and a single transistor. The schematic

diagram of the device is traced and explained; the circuit board foil pattern and component layouts are presented. The device is contained in a 100 x 100 x 45 mm plastic box with a variable capacitor, pointer-type indicator, switch and jack on the front panel. The operation of the device is explained.  
[245-6900]

UDC [621.314.222.6:665.6].001.24

NEW SERIES OF TRANSFORMERS FOR SUBMERSIBLE ELECTRIC PUMPS IN OIL EXTRACTION RIGS

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 5, May 84 pp 29-33

GENDEL'MAN, G. A., candidate of technical sciences, Special Design Office for construction, study, and installation of stemless pumps; MALAKHOV, I. S., engineer, State Committee at the USSR Council of Ministers on Material and Equipment Supply; KOSHCHEYEV, A. A., engineer, Ministry of the Petroleum Industry, GOL'BERG, G. Ye., engineer, Minsk Electrical Equipment Manufacturing Plant, and SHVARTS, D. L., engineer, Special Design Engineering and Manufacturing Office for submersible electrical equipment for oil well drilling and oil extraction

[Abstract] A new series TMPN-82 of three 3- $\emptyset$  transformers with smooth wide voltage regulation have been developed for pump motors in oil drilling and extraction rigs, for 6(10)/0.4 kV step-down and 0.4/ $V_m$  kV step-up ( $V_m$  - nominal pump-motor voltage), to replace the six existing TMPN-73 high-loss transformers. The high-voltage winding and the low-voltage winding are designed especially for this application, the latter consisting of two electrically isolated coils and equipped with a rack-type transfer switch for fine voltage regulation within one step on the high-voltage winding. The new TMPN-82 100 kVA transformer with an 800-1600 V regulation range is equivalent to three TMPN-73 transformers (63 kVA/856 V, 100 kVA/1170 V, 150 kVA/1610 V), the new TMPN-82 160 kVA transformer with a 450-1200 V regulation range to one TMPN-73 transformer (100 kVA/1170 V), and the new TMPN-82 235 kVA transformer with a 1650-2400 V regulation range to two TMPN-73 transformers (160 kVA/2050 V, 200 kVA/2050 V). An evaluation of the cost effectiveness of halving the number of transformer sizes, two of them matching more motor sizes, is evaluated in terms of lower power losses and lower interchanging and replacement costs. Figures 1; tables 3. [299-2415]

## CALCULATION OF EXTERNAL MAGNETIC FIELD OF A SHIELDED TRANSFORMER

Moscow ELEKTRICHESTVO in Russian No 5, May 84 (manuscript received 28 Jun 83)  
pp 35-39

VASYUTINSKIY, S. B., RUSANOV, B. V. and STEPANOVA, I. P., LPI (probably  
Leningrad Polytechnical Institute)

[Abstract] It is difficult even by computerized numerical methods to compute external magnetic fields from shielded transformers by direct determination of boundary conditions for three-dimensional piecewise nonhomogeneous regions. Because the effects are important at a considerable distance, an approximation method is proposed with acceptable results for points at distances 1.5-2 times the longest transformer dimension. The real shields are conceived as spherical and the transformer as a set of paired magnetic charges. The superposition method is used and field spherical harmonics are determined for the paired charges inside the shielding. Shield coefficients are established for different harmonics and external field harmonics are computed with the shielding. The effective shield coefficient is established for points of interest. The number of field harmonics depends upon the desired precision and increases as computation points approach the charges. Shield coefficients depend upon harmonic orders and the characteristics of the shields and not on the arrangement of the field sources and computation point coordinates. In general, the shield coefficient of two spherical shields is not the product of the screen coefficients, but is equal to this product if the screens are sufficiently far apart. An experiment showed an error of 11% for computed values for a transformer and much greater errors for a coil and bar apparatus. Figures 3, tables 2, references 7: 6 Russian, 1 Western.  
[293-12497]

## SELECTION OF LOCATIONS FOR STRONG AUTOMATIC FIELD CONTROL IN LARGE POWER SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 5, May 84 (manuscript received 20 Oct 83)  
pp 42-44

KHRISTOV, Kh. K., candidate of technical sciences, Sofia, People's Republic  
of Bulgaria

[Abstract] Power system stabilizers and feedback systems for regulating large-scale power systems require the selection of optimal arrangements of the minimum number of automatic disturbance regulators in the system for transient process control. Known methods involving linearized equations of transient processes requiring determination of coefficients for the sensitivity of the real parts of roots to the regularizing signal input to generators and

determination of eigen values and vectors involve complex programming. The paper considers system modelling for regulator location based upon analysis of system oscillations and regulation effects with simplification of transient process behavior criteria through the use of oscillation range values. Complete modelling of regulators is too complex and an approximation was used which was applied to the Bulgarian network (47 generators and 280 lines). Four stations for regulator location were selected and 15 variants sorted with 2 stations as the final result. The proposed model relatively quickly solves the regulator location problem for comparatively high frequencies (above 0.5 Hz) but is less effective for lower frequencies because transients are longer, but improvements are possible. References 3: 1 Russian, 2 Western.  
[293-12497]

UDC 621.313.019.34.001.4

#### COMBINED APPROACH FOR EVALUATION OF ELECTRIC MACHINE RELIABILITY

Moscow ELEKTRICHESTVO in Russian No 5, May 84 (manuscript received 22 Apr 82)  
pp 52-54

GORBUNOV, A. G., candidate of technical sciences, GOL'DBERG, O. D., doctor of technical sciences and IRTYSHSKIY, E. B., candidate of technical sciences, Otdeleniye VNIIE (Department All-Union Scientific-Research Institute of Electrical Machines), Istra

[Abstract] Reliability testing for electrical machines is laborious and time consuming especially if small batches are produced where conventional methods are less effective. Rapid testing procedures were developed for small batches involving the establishment of a set of machine parameters relating to bearing elements, vibrations, lubrication, play in commutators and winding and insulation states which can serve as indicators of machine states. On the basis of these parameters an a priori-empirical distribution law was developed which is 7-9 times more effective than other methods and can be used to establish distributions for small batches while the confidence level for reliability indicators is not less than 0.90-0.95. The method was used to evaluate the reliability of small batches of asynchronous motors with power of 0.7-200 kW and to establish trouble-free time distributions. Results were good within determined limits. Figures 6, references: 5 Russian.  
[293-12497]

## OPTIMIZATION OF DESIGN PARAMETERS FOR ALTERNATING CURRENT STABILIZER BASED ON MAGNETIC SUSPENSION

Moscow ELEKTRICHESTVO in Russian No 5, May 84 (manuscript received 29 Aug 83)  
pp 67-69

BUL', B. K., doctor of technical sciences, ABDULLAYEV, Ya. R., candidate of technical sciences, and ALEKSEYEV, A. V., engineer

[Abstract] In the design of magnetic suspension AC stabilizers a set of factors destabilizing left-hand winding dynamics are computed and values established for winding heat-up, duty cycle factor and winding materials densities and resistivities. The objective is to design the magnetic suspension so that disturbances will not put the stabilizer out of order utilizing the minimum amount of materials. A method was developed showing that the mass of materials and parameter optimization depend upon two dimensionless variables. A nonlinear program was created in order to find the variable function minimum and computations on the Elektronika D3-28 computer showed an error not greater than for previous methods. Precision depends upon a uniform magnetic field in the suspension gap and almost not at all on stabilizer geometry. The new method made it possible to construct stabilizers containing 30-40% less mass than previous designs and can be used for other suspension-type equipment. Figures 3; references: 5 Russian.  
[293-12497]

## STANDARD SERIES OF DIRECT-CURRENT MOTORS FOR REGULATED ELECTRIC DRIVES

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 30 Aug 83)  
pp 2-4

CHOLEWICKI, I., engineer, and LUBINA, M., engineer, Polish People's Republic, KOZHEVNIKOV, V. A., candidate of technical sciences, and KOCHNEV, A. V., engineer, USSR, ŠKODA, K., engineer, and VOLESKIY, E., engineer, Czechoslovak Socialist Republic

[Abstract] A standard series of d.c. motors for electric drives with speed and torque regulation has been developed since 1979 by CEMA's Interelektro Task Group 3, with Poland in charge of overall coordination and Czechoslovakia in charge of scientific research activity. Simultaneously, thyristor-type converters for machine tools with digital program control are being developed. The four essential objectives of this development are predicting the main technical and economic indicators on the basis of worldwide demands and trends

beyond 1985, standardization of main performance characteristics, standardization of protective and test equipment, establishing production quotas and tooling up for them. The seven major design goals are ensuring normal operation of motors energized through thyristor circuits, increasing the specific power and torque, expanding the range of speed regulation upward and downward, increasing the efficiency, improving the reliability under fast varying loads and under current-overload conditions, abatement of vibration and noise, and expanding the scale of nominal voltages while departing from rigid power and speed ratings so as to increase the number of motor sizes. Meeting these goals requires modification of the motor frame from the conventional round to a nearly square one, a larger ratio of armature stack length to diameter, better cooling, and insulation of a higher temperature class. In addition, it is necessary to laminate the housing partially or completely and to include a compensating winding. The basic motor configuration is 1 M 1001, according to CEMA Standard 246-78, with at least IP 22 or IP 23S protection and 1C 06 or 1C 05 cooling (shaft height from 112 mm up) and 1C 01 cooling (shaft height up to 250 mm). The series PI motors will be designed for a reference speed of 1500 rpm with not more than 15% armature current fluctuation, with speeds of 300-3000 rpm depending on voltage and motor size and torque regulation 1:200 (externally cooled motors) or 1:5, 1:10, 1:30 (self-cooled motors). Prototype motors with 132 mm and 355 mm shaft heights have already passed all tests. Figures 3; tables 1.  
[300-2415]

UDC 621.313.13-713.3.036.2

#### EFFECT OF POLYMER ADDITIVES ON CHARACTERISTICS OF DIRECT-CURRENT MOTOR WITH LIQUID DIELECTRIC FILLER

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 1 Dec 83)  
pp 4-7

IVANOV, V. I., candidate of chemical sciences, BASHKATOVA, S. T., candidate of chemical sciences, LUBSANOVA, A. A., engineer, TOKAREV, S. B., engineer, ZADAROVHAYA, G. N., engineer, and PASTUKHOVA, I. N., engineer, Moscow Order of Lenin Power Engineering Institute

[Abstract] In d.c. motors filled with dielectric of the hydrocarbon kind hydrodynamic losses can constitute up to 40% of the total losses. Consequently, a study was made in order to determine the proper additive and amount of it which will reduce the hydraulic drag without dehomogenizing the liquid filler over long operating periods. As suitable additives were selected two polymethacrylates of the  $-\text{CH}_2-\text{C}(\text{CH}_3)(\text{COOR})-$  form, with  $\text{R} = (\text{CH}_2)_{15}\text{CH}_3$  or  $(\text{CH}_2)_{13}\text{CH}_3$ , respectively, never before used for this application. Two motors of different sizes, a 0.8 kW DPK and a 6 kW DPK, were tested in kerosene with 0.005-1.0 wt.% of these additives. They were driven by an external d.c. motor with speed regulation, power losses were measured and segregated by the standard method. A comparative evaluation of the data, including the hydraulic drag

coefficient as function of the Reynolds number and the temperature rise at critical motor components (armature winding in slots, armature endturns on drive side, armature teeth, liquid in interpolar space, field winding, pole pieces) with or without additive, has yielded the optimum range of additive concentration for each motor size. An evaluation of the heat transfer at critical surfaces, with the aid of dimensional analysis, has yielded the semiempirical relation  $Nu = C Re^{0.65} Pr^{0.4} K^m$  (C- constant factor different for each surface,  $K^m$ - constant factor with exponent different for each additive polymer materials). The results can be extended to transformer oil and diesel oil as liquid motor-filling medium. Figures 6; tables 2; references: 5 Russian. [300-2415]

UDC 621.313.333.042.14.001.6

#### INDUCTION MOTORS WITH MINIMUM WASTE OF MAGNETIC IRON

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 6 Jul 83) pp 12-14

BOYKO, Ye. P., candidate of technical sciences, MAKAROV, F. K., candidate of technical sciences, KREMESHNYY, Yu. A., candidate of technical sciences, and STEPANYANTS, E. A., candidate of technical sciences, All-Union Scientific Research and Design Technological Institute of Electrical Machines

[Abstract] An induction motor with minimum waste of magnetic iron has been developed as an equivalent of the commercial 4A80A4 motor. The stator core is made of silicon-iron steel strip, its width equal to the core height, and wound on edge to form a stack. Stator slots closed on the bore side and open on the outside for winding are formed together with teeth separating them by corrugating a silicon-iron steel strip of width equal to the stack length and sliding it, after winding, inside the core with an insulation interlayer between them. The thickness of this interlayer does not exceed 20% of the air gap between stator and rotor, but even this degrades the motor starting and running performance. The performance is also degraded by leakage of magnetic flux through the slot "bridge" on the bore side and by nonuniformity of the air gap width resulting from corrugation of the stator bore surface. These drawbacks are partly compensated by lining the slots with film insulation instead of sleeves or tubes, thus making more slot space available for copper, and finish by grinding of the stator bore surface. Prototypes were built with 0.5 mm thick strip of 2212 steel for the teeth and strip of 08KP steel for the core, separated by a 0.03 mm layer of EKD-14 epoxy compound, with the air gap correspondingly narrowed from 0.25 to 0.2 mm. The stator winding is a single-layer one of enamelled and triple vinyl-covered 0.67/0.73 mm copper wire, the slots insulated with Dacron film. The performance of this motor is still inferior to that of the 4A80A4, but experimental studies have revealed several possibilities of improving it through better technology of stator manufacture, also of rotor manufacture along the same concepts but with slots designed to accommodate cast aluminum rather than copper conductors. Figures 4; tables 1; references 8: 5 Russian, 3 Western (in Russian translation). [300-2415]

MAGNETIC FIELD AND EQUIVALENT CIRCUIT OF INDUCTION MOTORS WITH SHIELDED POLES

Moscow ELEKTROTEKHNIKA in Russian No 5, May 84 (manuscript received 28 Jul 83)  
pp 14-16

KATKYAVICHYUS, V. I., candidate of technical sciences, BUKSHNAYTIS, I. V.,  
candidate of technical sciences, and BANITE, D. K., engineer

[Abstract] The magnetic field distribution in the air gap of induction motors with shielded poles is calculated, taking into account forward and backward harmonics as well as their skew. An analysis is made on the basis of theoretically or experimentally determined magnetic induction (flux density) rather than by the method of symmetrical components. Measurements were made with a search coil along the stator bore and an R-56 a.c. compensator. The magnetic field is calculated as the sum of fields alternating under the shielded part and the unshielded part of the pole arc, from values at points separated in time by quarter periods of the fundamental component. An equivalent circuit diagram is then constructed, assuming a sinusoidal input voltage at the stator. Figures 3; references: 4 Russian.  
[300-2415]

SLIDING DISCHARGE IN CO<sub>2</sub> AND EXCIMER LASERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 7, Jul 84  
(manuscript received 24 Jun 83) pp 1217-1241

ZAROSLOV, D. Yu., KUZ'MIN, G. P. and TARASENKO, V. F.

[Abstract] Research on discharges sliding along the surface of a dielectric performed in the USSR and elsewhere is reviewed. It is reported that such discharges can be used to develop open-type UV radiation sources with energy, spectral and temporal properties suitable for use as pre-ionizers and plasma electrodes in pulsed and pulse-periodic molecular lasers. It has been found that plasma electrodes in pulsed and molecular lasers are competitive with accelerated electron beams for pre-ionization of the active medium. The use of sliding discharge for dimensional working of thin polymer films in sub-micron photolithography is discussed. The use of sliding discharges to initiate chemical HF-lasers is described. The authors thank N. V. Karlov, at whose initiative this review was written. Figures 19; references 63: 47 Russian, 16 Western (2 in Russian translation).  
[318-6900]

## SOLID STATE CIRCUITS

### CONFERENCES OF QUANTUM-RADIOOPTICS SECTION

Moscow RADIOTEKHNIKA in Russian No 5, May 84 p 93

MIKAELIAN, A. L. and KOBLOVA, M. M.

[Abstract] A joint conference was held on 28-29 June 1983 at the Kaunas Polytechnic Institute in Kaunas by the Quantum-Radiooptics Section of the Scientific and Technical Radio Engineering, Electronics and Communications Society imeni A. S. Popov and the Continuous Seminar on Theory of Mechanisms and Machines at the USSR Academy of Sciences. The subject of the conference were problems of producing optoelectronic devices, utilizing latest developments in optical disk memories, optical systems for permanent information storage, and laser systems for information retrieval. The three most interesting reports were those by L. V. Vydrin on hologram readout with gap stabilization within  $\pm$  micrometer, by V. A. Kurilo on X-Y plotters with vibrometers running at frequencies up to 100 kHz with smooth or stepwise current regulation to move a mass of up to 10 kg, and by R. G. Naumyavichus on position, velocity, acceleration transducers providing feedback for precision placement of heavy equipment weighing 100-2000 kg on a platform.

[301-2415]

USE OF OPTICAL BAND PHASE SYSTEMS IN TRANSPORTATION ROBOTS

Moscow RADIOTEKHNICA in Russian No 5, May 84 (manuscript received, after completion, 26 Jul 83) pp 80-81

MERKISHIN, G. V.

[Abstract] Use of optical band phase systems for controlling the movement of a transportation robot-vehicle is considered, in the column behind a leader or according to a program with orientation relative to reflectors installed at key points along the route. A special-purpose light reflector or any obstacle along the path returns the optical signal to a harmonic intensity modulator, whereupon two phases of the envelope of the returning signal are measured by two photoreceivers which also compare this signal with the reference signal from a separate light source. The two phases are compared by an analyzer and the control signal is generated on this basis, the phase difference being almost zero when the reflector is far from the trolley and becoming large when the reflector is near. An extraneous object produces a parasitic reflection signal. The performance of such a distance and direction measuring system which contains a 2 mW light source, an  $m = 0.3$  OLMSH modulator, a  $15^\circ$  objective, and  $45^\circ$  spherical reflectors is evaluated in terms of energy transfer and signal-to-noise ratio. Oscillations of the vehicle with attendant rotation of the radiation pattern of the light source mounted on it do not significantly affect the phase measurement accuracy as long as the signal-to-noise ratio does not drop below unity, in which case it becomes necessary that the measuring system automatically track the maximum of the reflected signal. Figures 2; references 3: 2 Russian, 1 Western.  
[301-2415]

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